BONE MARROW FINDINGS IN GERIATRIC PATIENTS

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I hereby declare that the thesis entitled **"BONE MARROW FINDINGS IN GERIATRIC PATIENTS"** submitted towards partial fulfillment of the requirements for the award of **MD IN PATHOLOGY** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Bhavna Malhotra,** Professor, Department of Pathology, **Dr. Dinesh Gupta**, Professor & Head, Department of Medicine, & **Dr. Vikram Narang,** Associate Professor, Department of Pathology. No part of this thesis has formed the basis for the award of any degree previously.

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Dedicated

to

my family

&

Teachers

LIST OF ABBREVIATIONS

1. HMs-Hematologic malignancies
2. WHO-World Health Organization
3. MDS-Myelodysplastic syndrome
4. MPNs-Myeloproliferative neoplsms
5. PCR-Polymerase chain reaction
6. BMB-Bone marrow biopsy
7. HSCs-Haematopoietic stem cells
8. WBC - White blood cell
9. Ph-Philadelphia
10. CML- Chronic myeloid leukemia
11. ACI- Anemia of chronic inflammation
12. MCV-Mean cell volume
13. MCHC-Mean corpuscular hemoglobin concentration
14. MCH-Mean corpuscular hemoglobin
15. RDW-Red cell distribution width
16. TLC-Total Leucocyte Count
17. MPV-Mean platelet volume
18. Hb-Hemoglobin
19. RBC- Red blood Cell Count
20. PLT-Platelets
21. EDTA-Ethylene di-amine tetra acetic acid
22. TNF- Tumor necrosis factor alpha
23. IL-6- Interleukin-6
24. AML-Acute myeloid leukemia

25. ALL- Acute lymphoblastic leukemia(
26. MPO-Myeloperoxidase
27. PAS-Periodic Acid Schiff
28. CLL-Chronic lymphocytic leukemia
29. CML-Chronic myelogenousleukaemia
30. MDS -Myelodysplastic syndromes
31. FAB- French American British
32. HCL- Hairy cell leukaemia
33. BM- Bone marrow
34. MGUS-Monoclonal gammopathy of undetermined significance
35. NHL- Non-Hodgkin's lymphoma
36. PUO- Pyrexia of unknown origin
37. ESR- Erythrocyte sedimentation rate
38. PCM- Plasma cell myeloma
39. ET-Essential thrombocythemia
40. CMML-Chronic myelomonocytic leukemia
41. CLL- Chronic lymphocytic leukemia
42. MM-Multiple myeloma
43. ITP-Idiopathic thrombocytopenia
44. LAP-Leucocyte alkaline phosphatase
45. PBF-Peripheral blood film
46. HLH-Hemophagocyticlymphohistiocytosis
47. ZN-Zeihl-Neelsen
48. AFB-Acid fast bacillus

49. TLC-Total leucocyte count
50. IHC-Immunophistochemistry
51. IFE- Immunofixation electrophoresis
52. ANA-Antinuclear antibodies
53. SPE- Serum protein electrophoresis

ABSTRACT

Introduction: Geriatric population is increasing in india due to increasing life expectancy. Hemograms, Peripheral blood smears and Bone marrow examination including both aspiration and biopsy are important investigation for diagnosing the haematological disorders. This study therefore was conducted to diagnose the hematological disorders in geriatric population by all the above investigations.

Aims & Objectives: To evaluate the hematological disorders in geriatric patients.

Material and method: This was a descriptive and prospective study of 12 months from March 2021 to March 2022 ,conducted in the Department of Pathology, Dayanand Medical College and Hospital, Ludhiana. The geriatric patients (60 and above) were included and their hemograms, peripheral blood smears and bone marrow aspiration and biopsies were critically analysed.

Results: Total 206 cases underwent bone marrow examination and the age range of the patients was 60 to 92 years, with male to female ratio of 1.6:1. The most common indication being suspicion of multiple myeloma(23.0%) followed by pancytopenia (17.%). Neoplastic cases in this study was 116 and non-neoplstic cases were 90. Among neoplastic cases, multiple myeloma was most common [18.9% cases] followed by myeloproliferative neoplasm [12.1%], lymphoproliferative neoplasm [10.6%], acute leukemia [7.7%], myelodysplastic syndrome [5.8%] , metastasis [1.4%], CMML [0.4 %]. Among non neoplastic cases, Idiopathic thrombocytopenic purpura was most common diagnosis [13.5%] followed by megaloblastic anemia[5.3%]

Conclusion: Malignancy risk increases with age, contributing to mortality and morbidity in the elderly. Bone marrow aspiration and trephine biopsy are important tools in the evaluation of elderly patients with hematologic and non-hematologic disorders

Keywords: Hemograms, Peripheral blood smears, Bone marrow Aspiration and Biopsy, Elderly patients, Anemias, Leukemias, Multiple myeloma

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KEY TO MASTER CHART

HTN - HYPERTENSION

DM - DIABETES MELLITUS

TB - TUBERCULOSIS

CKD - CHRONIC KIDNEY DISEASE

RA - RHEUMATOID

M - MALE

F - FEMALE

HB - HEMOGLOBIN

TLC - TOTAL LEUCOCYTE COUNT

RBC - RED BLOOD CELL COUNT

PLT - PLATELETS

ALL - ACUTE LYMPHOBLASTIC LEUKEMIA

MPO -MYELOPEROXIDASE

PAS -PERIODIC ACID SCHIFF

CLL -CHRONIC LYMPHOCYTIC LEUKEMIA

CML -CHRONIC MYELOGENOUSLEUKAEMIA

MDS -MYELODYSPLASTIC SYNDROMES

FAB - FRENCH AMERICAN BRITISH

HCL - HAIRY CELL LEUKAEMIA

BM - BONE MARROW

MGUS-MONOCLONAL GAMMOPATHY OF UNDETERMINED SIGNIFICANCE

NHL - NON-HODGKIN'S LYMPHOMA

ET -ESSENTIAL THROMBOCYTHEMIA

CMML-CHRONIC MYELOMONOCYTIC LEUKEMIA

CLL - CHRONIC LYMPHOCYTIC LEUKEMIA

MM -MULTIPLE MYELOMA

ITP -IDIOPATHIC THROMBOCYTOPENIA

LAP -LEUCOCYTE ALKALINE PHOSPHATASE

HLH -HEMOPHAGOCYTICLYMPHOHISTIOCYTOSIS

MDS -MYELODYSPLASTIC SYNDROME

MPNS -MYELO PROLIFERATIVE NEOPLSMS

IHC -IMMUNOPHISTOCHEMISTRY

IFE - IMMUNOFIXATION ELECTROPHORESIS

ANA -ANTINUCLEAR ANTIBODIES

SPE - SERUM PROTEIN ELECTROPHORESIS

AML -ACUTE MYELOID LEUKEMIA

CML - CHRONIC MYELOID LEUKEMIA

ACI - ANEMIA OF CHRONIC INFLAMMATION

APML - ACUTE PROMYELOCYTIC LEUKEMIA

Y - YES

N - NO

INTRODUCTION

As the general population ages, hematologic disorders in the elderly have become a growing concern. Although hematologic measurements are the same in elderly patients as in younger patients, the elderly patient's bone marrow's ability to respond to increased demands may be blunted.[1-2] The reconstituting capacity of hematopoetic stem cells (HSC) appears to be reduced in older patients compared to younger patients, though the reason for this is unknown.[1,3] Stress, such as bleeding or infection, can reveal underlying age-related hematopoetic defects, resulting in a slowed bone marrow response. This could be due to a paradoxical decrease in progenitor cells compared to the increase seen in younger patients. This results in a reduced reticulocyte response to bleeding and an impaired white blood cell response to infection in clinical terms. Epigenetic changes, DNA damage, telomere erosion, increased apoptosis, and immune function changes may all play a role.[1]

Anemia has emerged as a significant risk factor in the last decade, linked to a variety of negative outcomes in the elderly, including hospitalisation, disability, and death. Anemia is a subtle disease that is linked to a variety of negative health outcomes in the elderly.

Hematologic malignancies are a broad category of blood cancers with varying causes, incidence, prognosis, and survival.[4] In population studies, HMs are classified into four types: Leukaemia, Hodgkin lymphoma, Non-Hodgkin lymphoma, and myeloma. The World Health Organization (WHO) has recently developed a consensus-based classification in which HMs are classified based on their lineage (myeloid and lymphoid) and cell maturity[4]. To further subdivide each category, this classification employs morphology, immunophenotype, genetic, and clinical criteria.

Bone marrow is composed of (a) hemopoietic stem cell cellular elements, proliferating and differentiating progenitors, and morphologically recognisable precursors, and (b) stroma. The interaction between stromal cells and hemopoietic progenitor cells is critical. Erythroblasts are found in the centre of the bone marrow, close to sinusoids. Myeloblasts are frequently found near trabecular surfaces. Megakaryocytes are found in the centre of the bone marrow, alongside erythroid and myeloid precursors. Monocytic precursors are typically undetectable in bone marrow sections. Lymphocytes are found in the central parts of the marrow, both interstitially and around arterial vessels.

A bone marrow examination is an important investigation for the diagnosis and treatment of many haematological and non-hematological illnesses in patients of all ages. This could be caused by changes caused by ageing at the DNA or protein levels in various cells and tissues.[5] There is little published data on the indications for and diagnostic value of bone marrow biopsies in the elderly population, defined as individuals 60 years of age or older. It appears plausible that the symptoms and diagnoses established, as well as how these diagnoses affected treatment, would differ for this subpopulation. This information is important as India's population ages and more elderly people may require bone marrow testing. Our institution is particularly interested in it, as a public tertiary care facility in a state with one of the highest percentages of senior citizens. This subpopulation's indications and diagnoses, as well as the impact of these diagnoses on therapy, appear to be different. This information is important as India's population ages and the number of elderly patients undergoing bone marrow studies rises.

Hemograms, peripheral blood smears, bone marrow aspiration, and biopsy are all very useful in determining the presence of haematological and non-hematological disorders. The two most important diagnostic techniques for haematological disorders are bone marrow aspiration and

trephine biopsy, which are complementary to one another. The bone marrow examination may either confirm a clinically suspected disease or reveal a previously unknown diagnosis[6]. The aspirate contains semi-liquid bone marrow that can be examined under a light microscope and analysed using flowcytometry, chromosome analysis, polymerase chain reaction (PCR), and culture. Bone marrow aspiration provides cytologic information, improved morphology, and distinct cell counts. A trephine biopsy is frequently performed, yielding a narrow, cylindrically shaped solid piece of bone marrow that is examined microscopically (sometimes with the aid of immunohistochemistry) for cellularity and infiltrative processes. When it comes to detecting focal lesions, bone marrow biopsy (BMB) is more sensitive. Marrow reserve is more valuable on BMB. BMB can also be used to demonstrate antigens immunohistochemically. Bone marrow biopsy evaluates cellularity and architecture, is critical for diagnosing "dry or blood tap," and aids in the detection of localised lesions [5].

This study looked at bone marrow changes in people over the age of 60 who had a variety of signs and symptoms, most commonly cytopenia.

As a result, the current study is being conducted to investigate the indications and morphological features of bone marrow examination in the geriatric population.

AIM & OBJECTIVES

To evaluate the hematological disorders in geriatric patients.

REVIEW OF LITERATURE

Background:

The overall population's life expectancy has increased dramatically over the last century, and further increases are expected. [7-8] People over the age of 65 are more than twice as prevalent today as they were a century ago. The number of people over the age of 65 increased from 19 million to 35 million between 1965 and 2000. [9] During the same time period, the population of people over the age of 80 increased from around 3 million to over 9 million. By 2030, people over the age of 75 will be multiplied by three, and those over the age of 85 will be multiplied by two.[10] It has been observed in the last 10 to 15 years that there is an unexpected epidemic of hematologic diseases in the elderly. It was discovered that the burgeoning population over the age of 80 has a high incidence of certain hematologic diseases.[9]

As the general population ages, hematologic disorders in the elderly have become a growing concern. Haematopoietic stem cells (HSCs) are responsible for the production and replenishment of blood cells of all types throughout life. The stem cell niches are composed of stromal cells which are vital for adult haematopoiesis. With increasing age the haematopoietic system undergoes substantial changes. With age there are striking changes in functional capacity and quantity of blood cells with decreased competence of the adaptive immune system, elevated incidence of age-associated anaemia and increased haematological malignancies.

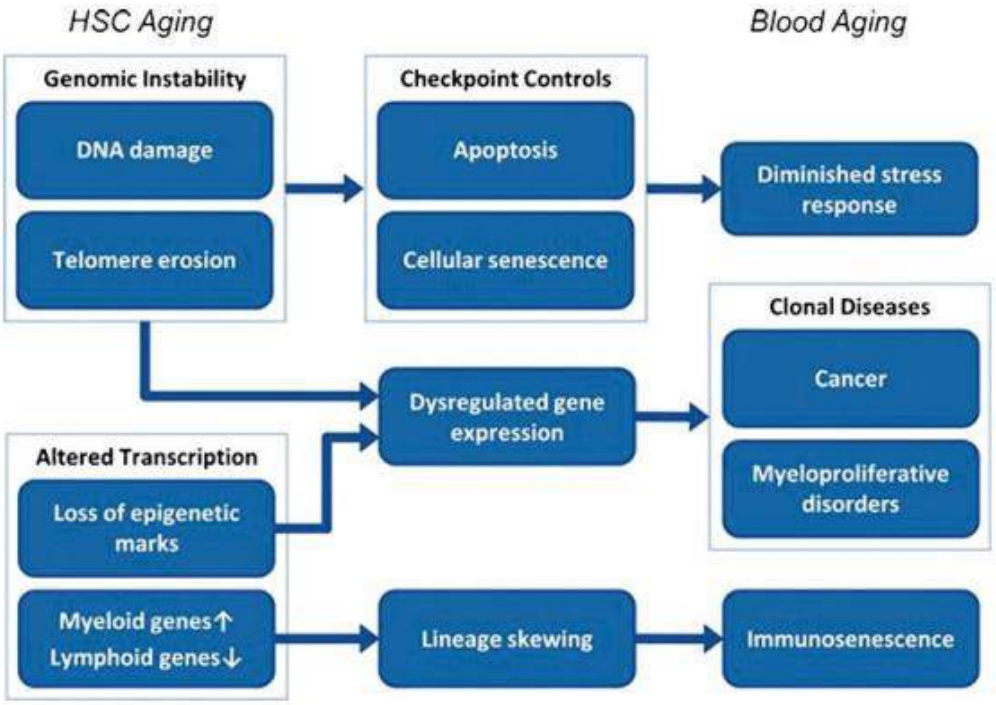
Although hematologic measurements are the same in elderly patients as in younger patients, the ability of the bone marrow to respond to increased demands may be blunted in the elderly patient.[1,2] There does appear to be a reduction in the reconstituting capacity of hematopoetic stem cells (HSC) from older patients when we compare to younger patients ,but the reason for this is unclear.[1,10] Stress, such as bleeding or infection, may

unmask underlying age associated hematopoetic defects resulting in an impaired bone marrow response. This may be due to a paradoxical reduction in progenitor cells compared to the increase in progenitors seen in younger patients. Clinically this leads to a reduced reticulocyte response to bleeding and a reduced white blood cell response to infection[1,11] Epigenetic changes, DNA damage, telomere erosion, increased apoptosis, and alterations in immune function may play a role[1,12]

AGING AND HEMATOPOIESIS

The hematopoietic system of healthy elderly people who are not subjected to hematopoietic stress such as blood loss or infection closely resembles that of young adults. For example, the bone marrow cells remain normal in quantity, although their location is anatomically shifted towards the axial skeleton, and the number of hematopoietic progenitors remains intact.[10] The most noticeable change is a decrease in marrow cellularity. The percentage of marrow space occupied by hematopoietic tissue decreases from 40-60% in young adults to 20-40% in older people, with fat taking up the remaining space..[13] These observations of normal steady-state (unperturbed) hematopoiesis are consistent with the findings that the hematocrit, hemoglobin, and white blood cell (WBC) and platelet counts of elderly people do not differ from those of young adults. Therefore, no age-specific adjustments are needed for the interpretation of complete blood counts in the elderly. Nevertheless, studies have revealed that, during hematopoietic stress, blood cells of older animals and humans are not replaced as promptly as those of their younger counterparts.[14] Consequently, the application of hematopoietic stress unmasks the age associated defect in hematopoiesis, which can be referred to as a latent age-associated defect. This inability to replace blood cells normally closely correlates with an increase in the prevalence of anemia in the elderly, which is most evident in hospitalized elderly patients.[10,14]

Effect of aging on hematopoetic stem cells and the development of blood disorders-



With age, stem cells accumulate DNA damage, whereas the slow cycling of the HSC pool results in telomere erosion. Cells have defence mechanisms that detect genomic damage and initiate programmed cell death or permanent cell-cycle arrest to reduce the risk of oncogenesis (apoptosis and cellular senescence). The frequency with which these pathways are activated in HSCs and their downstream progeny increases as the burden of unrepaired damage in the stem cell pool increases, while average HSC regenerative potential decreases. Although this does not result in stem cell exhaustion in normal ageing, it does reduce the reserve capacity to meet hematopoietic stress. Genomic damage and epigenetic instability can also result in the malignant transformation of HSCs, progenitors, or effector cells, manifesting as cancer or myeloproliferative disorders acutely or chronically. The propensity of HSCs to differentiate

into different blood cell lineages is altered by changes in gene expression as they age, a phenomenon known as "lineage skewing." Lymphoid progenitor cell numbers decline with age, contributing to a decrease in the production of naive B and T cells. A shift in the population of peripheral lymphocytes toward antigen-experienced memory cells and away from naive cells underpins immunosenescence's declining response to infection. [1]

Mutations or asymmetric divisions in immature blood cell lines, as well as specific chromosomal abnormalities (numerical and structural), such as aneuploidies, deletions, translocations, and inversions, are frequently associated with haematological malignancies. [15-17] Peter Nowell and David Hungerford discovered the Philadelphia (Ph) chromosome in blood samples from a patient with chronic myeloid leukaemia in 1960, and it was the first chromosomal alteration linked to cancer (CML). [15,18] Cytogenetic diagnosis of chromosomal alterations in haematological malignancies has since aided physicians and researchers in the classification, staging, and prognosis of these neoplasms. [15,19] Some epidemiological studies have identified ageing as the primary risk factor for the development of cancer[15,20]. In addition to decreased immune system efficiency in the elderly, bone marrow loses its ability to properly replace blood cells [15,21]. In blood samples, about 2-3% of the elderly have chromosomal abnormalities caused by clonal mosaicism. The presence of these abnormalities is linked to a tenfold increase in the risk of developing haematological malignancies [15,22].

HISTORICAL PERSPECTIVE:

Surgical trephine biopsy is an older procedure than needle marrow aspiration. Pianese was the first to obtain marrow from the femoral epiphysis in 1903. Trephine biopsy was performed on the sternum, iliac crest, and tibia by subsequent workers[23]. The technique was abandoned due to the difficulty in obtaining adequate material and the time-consuming

procedure for preparing sections. As a result, bone marrow aspiration remained dominant in haematological diagnosis. Jamshidi and Swaim invented a new biopsy needle in 1971. Khosrow Jamshidi, an Iranian citizen, received his patent in 1971. The distal portion's interior diameter was tapered radially towards the cutting tip. This design allowed tissue to freely enter the lumen while avoiding tissue crushing [24]. In the last three decades, advances in needle trephine design, biopsy technique, and technical progress in their preparations have added impetus to the study of bone marrow as an organ with its architecture and components intact in their natural spatial context. This has provided a more comprehensive understanding of its role in health and disease.

BONE MARROW STRUCTURE

The soft, semisolid, red gelatinous bone marrow generated by mesenchyme is enclosed in the axial skeleton's medullary cavities. Adult bone marrow, which is composed of bone, vascular structures, and hemopoietic tissue, is the primary site of successful hemopoiesis. The medullary cavity is surrounded by trabecular bone, which is made up of periosteum, cortical bone, and subcortical bone. Arterioles, sinusoids, and tiny peripheral nerves pass through the interstitial space. Haematopoietic cells and stromal cells are cellular components of bone marrow. In the bone marrow, haematopoietic cells include stem cells, maturing granulocytic/myeloid cells, erythroid cells, megakaryocytes, lymphocytes, and plasma cells. Adipocytes, fibroblasts, dendritic cells, and macrophages are examples of stromal cells. Stromal cells play an important role in providing scaffolding for the marrow space as well as in the production of growth factors that control haematopoiesis. [25] The patient's age must be considered when assessing bone marrow cellularity, which refers to the relative proportion of fat and haematopoietic cells.

NORMAL BONE MARROW STRUCTURE:

ERYTHROCYTES: The erythroid cell series forms islands, nodules, or clusters in the inter-trabecular space. Immature cells reside in the centre of the island, while mature cells reside on the island's edges. Haemosiderin-pigmented macrophages can be found near the erythroid islands. The population is maturing at all stages. A normal myeloid-erythroid ratio in a biopsy ranges from 1.5 to 3:1.

GRANULOCYTES: In a bone marrow biopsy, all granulocytes and their precursors can be identified. They are paratrabecular, with developing cells moving toward the trabecular bone, and mature cells moving toward the marrow cavity. Myeloblasts are most commonly found adjacent to the bone marrow trabecular surfaces or arterioles[26]. Granules can be classified as neutrophilic (weakly eosinophilic) or eosinophilic (large, refractile, and strongly eosinophilic). Basophils are rarely seen.

MEGAKARYOCYTES:Their alignment is parasinusoidal. These are the largest, most pleomorphic cells found in bone marrow, ranging in size from 12 to 150 microns. Mature megakaryocytes have eosinophilic cytoplasm with varying granularity. The nucleus is multilobated and cerebriform in shape. Peripolesis can occur in megakaryocytes of any size.The sinusoids get the platelets directly.[26]

MONONUCLEAR MACROPHAGE SYSTEM: Monoblasts resemble myeloblasts morphologically, with the exception of the possibility of a slightly clefted or lobulated nuclear structure. Promonocytes are larger than monoblasts (15-20 microns) and have spherical nuclei with one or more visible nucleoli. Monocytes (15-18 microns) have a greenish cytoplasm and an abundance of intracytoplasmic vacuoles. The nucleus is abnormally kidney-shaped, with thin, lacy chromatin covering it. They can be confused with granulocytic precursors. Macrophages, which are descended from monocytes, are phagocytic cells found in bone marrow

and other tissue areas. Macrophages are larger than monocytes, measuring 20-30 microns in diameter. The nucleus is large, round to oval, and lace-like in appearance. It also has a lot of pale blue vacuolated cytoplasm with azurophilic granules and intracytoplasmic inclusions of different sizes and shapes filled with phagocytosed detritus. They are most commonly found in the centre of plasma cell islands, erythroid islands, and near endothelial cells.

LYMPHOCYTES: Lymphoblasts are the first cells to be identified morphologically and are found in the intertrabecular area. Their nucleus is oval and hyperchromatic, with one or two nucleoli, a narrow ring of deep blue cytoplasm, and a high nucleocytoplasmic ratio. Prolymphocytes have larger nuclei, coarser chromatin, and more cytoplasm in general. Adult lymphocytes are 7-10 microns in diameter, have a spherical nucleus with dense, coarse chromatin, discrete nucleoli, and sparse deep blue cytoplasm.[26]

PLASMA CELLS: Plasma cells are typically found in the adventitia of small blood arteries, but they can also be found individually and in groups throughout the intertrabecular region. Their eccentric nucleus with coarse chromatin and profoundly basophilic cytoplasm with a perinuclear clear zone are what set them apart. They are 10 to 18 microns in size.[26]

STROMA MARROW:

The bone marrow stromal cells are made up of adipocytes, osteoblasts, osteoclasts, endothelial cells, and fibroblast-like reticular cells. Adipocytes (fat cells) are the largest cells in the bone marrow stroma, with a diameter of about 80-90 microns. They are in close contact with stromal and hemopoietic cells. The adipocyte-to-hemopoietic cell ratio is inverse. What causes the inverse association of fat cells and hemopoietic cells is unknown. Osteoblasts are large, ovoid or cuboidal cells that measure 20-50 microns in diameter. The clear Golgi zone is separated from the

nucleus, and the osteoblasts have a lot of basophilic cytoplasm and a small, eccentric nucleus. Osteoblasts are uncommon in healthy adult bone marrow. Osteoclasts are multinucleated, pale blue cells with a lot of azurophilic granules in their cytoplasm. They can be at least 100 microns in diameter. Individual nuclei are distinct, regular, and spherical in shape. Endothelial cells are long, elongated cells with a moderate amount of cytoplasm and a flat, condensed nucleus. A reticulum or syncytium is made up of reticular cells, which are a type of cell. These cells are linked to reticular fibres, which are also produced by these cells and form a three-dimensional support network for the vascular sinuses and haematopoietic components. The fibres can be seen using silver staining and light microscopy.

DISORDERS IN THE ELDERLY

ANEMIA IN THE ELDERLY:

Blood problems develop in active, healthy elderly people in the same way that they do in younger adults, and they respond similarly to treatment. Aging, on the other hand, decreases physiological reserve capacity, which often reduces tolerance to physical activity and slows the rate at which many body functions return to normal after stress. In an elderly person, anaemia may cause far more disability than expected. Because of disease, the elderly are anaemic. Anemia is frequently a presenting sign of a serious underlying disease and should be treated as such at any age. Normal haemoglobin levels in the elderly are debatable [27-30]. Older people with mild anaemia should be treated the same as younger adults when it comes to diagnostic studies; otherwise, treatable anaemia and its associated underlying disease will go undetected. Anemia is a symptom of disease rather than a diagnosis. An accurate diagnosis is required for

successful anaemia management. Anemia in the elderly can be caused by a variety of factors.

Anemias caused by nutritional deficiencies

A recent study found that nutritional deficiencies accounted for one-third of anaemia in the elderly, with iron deficiency accounting for the other two-thirds [1,31].

Anemia due to iron deficiency

Iron deficiency is the most common type of malnutrition. It is a common reason for decreased haemoglobin synthesis. Symptoms of iron deficiency are linked not only to decreased oxygen transfer to tissues due to less haemoglobin, but also to iron deficiency [32].

The most common symptoms are lassitude, weakness, fatigue, dyspnea on exertion, and palpitations. Angina and congestive cardiac failure are possible, particularly in older patients. Low haemoglobin levels will be detected on a peripheral blood smear. Anaemia varies in severity. It is typically mild to moderate in severity. Depending on the severity of the anaemia, low MCV, low MCHC, low MCH, and high RDW will be present. Anisocytosis is a significant early sign of iron deficiency that has differential diagnostic value when quantified [32-34]. Microcytic hypochromic is the most common type. Poikilocytosis is also present seen as elliptical forms, pencil cells, and a few target cells in the smear. TLC and platelet count are normal but may be elevated in a few cases. The reticulocyte count is normal or may be low. A bone marrow aspiration reveals hypercellularity. The erythroid series exhibits hyperplasia with micronormoblastic reaction, with the cells being small in size and displaying many late forms with basophilic cytoplasm due to insufficient haemoglobinization, and the cytoplasmic edges are ragged. There is significant ineffective erythropoiesis, with intramedullary destruction.

Management entails not only treating iron deficiency but also identifying and, if possible, correcting the abnormality that is causing the anaemia.[35]

Vitamin B12 (Cobalamine) Deficiency

In young patients, vitamin B12 deficiency is uncommon. However, in patients over the age of 60, it occurs in 10-15% of cases. There are numerous causes of vitamin B12 deficiency in the elderly. Pernicious anaemia and food B12 malabsorption are the most common causes of B12 deficiency in the elderly. Pancreatic insufficiency, terminal ileal disease such as Crohn's disease, radiation enteritis, small bowel lymphoma, and nitrous oxide anaesthesia are all causes of B12 malabsorption.

Anemias, leucopenia and thrombocytopenia, anisopoikilocytosis, ovalomacrocytes, and hypersegmented neutrophils are the most common haematological manifestations [36].

However, macrocytosis can occur months before anaemia develops [37]. It is estimated that between 13 and 27% of pernicious anaemia patients do not have significant anaemia. [37-38] The hypersementation of neutrophils, which is characteristic of macrocytic anaemia, is also visible. The earliest hematologic finding may be hypersegmentation in neutrophils. [39-40] Untreated cobalamin deficiency can lead to pancytopenia. [40]

The bone marrow is hypercellular, and the erythroid cells have a larger nucleus and stippled chromatin than normal (megaloblasts). There are more immature erythroid cells than mature erythroid cells. Other cell lines, such as giant bands/metamyelocytes, hypersegmented polymorphs, and multinucleated megakaryocytes, show abnormal maturation. Iron levels in the stromal cells are elevated.

B12 deficiency responds quickly to replacement therapy. Carmel suggests starting with 1,000 mg intramuscular replacement. Weekly doses for four weeks can be given to replenish stores, followed by monthly supplementation. [1,41] Reticulocyte response occurs approximately one

week after the initial treatment, and complete hematologic recovery (normalisation of haemoglobin and MCV) should occur within eight weeks.

Deficiency in Folate

Folate needs are much higher and stores are much lower than in cobalamin deficiency.[1,42]

As a result, anaemia caused by a lack of folate develops in as little as two weeks with inadequate intake. The levels of folate in the blood and red blood cells are low. The findings on the peripheral blood film and bone marrow are similar to vitamin B12 deficiency anaemia.[1,42]

Anemia of chronic disease:

Anemia is common in elderly patients with chronic inflammatory conditions such as rheumatoid arthritis, infections such as tuberculosis or osteomyelitis, neoplastic disease, or, in rare cases, liver or renal disease. Anemia develops as a result of a defect in bone marrow production combined with a reduced compensatory marrow response to some shortening of the erythrocyte life span. The release of iron from reticuloendothelial cells is inhibited, resulting in low plasma iron. Because of the low concentration, the patient is sometimes mistakenly given long-term iron therapy. Aging is a protracted inflammatory process. [43] The prevalence of chronic inflammation anaemia increases with age. Changes in cytokines with age may contribute to anaemia as well as "frailty" in older patients [43]. The presence of low serum iron, low iron binding capacity, elevated ferritin, and low soluble transferrin receptor suggests chronic inflammatory anaemia. Diabetes, arthritis, atherosclerosis, and cancer are common in the elderly and are associated with the production of inflammatory cytokines such as tumour necrosis factor alpha (TNF), interferon gamma, and interleukin-6 (IL-6). Obesity, hyperlipidemia, and atherosclerosis are all associated with increased hepcidin production via increased activation and transcription of the HAMP gene. This can lead to

an increase in hepcidin production, iron immobilisation, and the development of chronic inflammatory anaemia. [44] The anaemia is generally normocytic and normochromic, with mild to moderate hypochromic (MCH 22-26 pg) and microcytic (MCV 70-80 fl) changes occurring on occasion. There may be mild to moderate anisocytosis and poikilocytosis. There are no diagnostic features in the bone marrow aspirate. It has normal or slightly increased cellularity. Although the myeloid:erythroid ratio may be elevated, it is unclear whether this is due to increased granulopoiesis, decreased erythropoiesis, or both.

Anemia due to renal insufficiency

Renal dysfunction may be a significant contributor to anaemia in the elderly. Renal function declines with age, even in otherwise healthy elderly patients. [1,45-46] A study of healthy, nondiabetic patients over the age of 60 found that renal function deteriorated with age[1,46]. Erythropoietin supplementation can treat severe anaemia caused by renal insufficiency. If the serum ferritin level is less than 500 mg/L, iron supplementation with erythropoietin stimulating agents may be indicated. [1]

Anaemia is uncommon unless the blood urea level is greater than 9 mmol/l; however, mild to moderate anaemia can occur when active renal infection is associated with mild impairment of renal function, even if the blood urea level is not elevated. The anaemia is neither normochromic nor normocytic. Initially, there is moderate anisocytosis, followed by poikilocytosis with the presence of 'burr' cells. The presence of fragmented, triangular, crescent-shaped 'helmet' cells, as well as microspherocytes and burr cells, strongly suggests the onset of micro-angiopathic hemolytic anaemia. It is normal for the reticulocyte count to increase moderately in the presence of some polychromasia.[46]

The bone marrow is normo- to hypocellular and may show severe erythroid hypoplasia and fibrosis around bone trabeculae. Erythroid hypoplasia can occur in severe uraemia. In severe renal failure, mild

dyserythropoiesis occurs. Leucopoiesis is normal, and the number of megakaryocytes is normal. The iron content of the marrow is normal.[47]

LEUKAEMIAS:

It is a clonal malignant disease of the haematopoietic tissue characterised by the proliferation of abnormal leukaemic blast cells in the bone marrow and the impairment of normal blood cell production. A peripheral smear will typically reveal normocytic normochromic anaemia with thrombocytopenia, leucocytes are increased, normal, or decreased. Most of the time, blasts are present. In subacute/aleukaemic leukaemia blasts are seen occasionally. Typically, the marrow is hyperplastic, with almost complete effacement of normal architecture. Fat cells are almost non-existent, and the marrow cavity is occupied by sheets of leukaemic cells, resulting in a uniform monomorphic picture.

The presence of >20% blast of all nucleated cells in the marrow is required for a leukaemia to be classified as acute. On the basis of cytoplasmic and nuclear features, experienced morphologists classify approximately 70% of acute leukaemias as lymphoid or myeloid. Lymphoblast nuclear chromatin is more clumped and irregularly distributed. The presence of nucleoli can vary. The chromatin in myeloid blasts is fine, delicately stippled or lacy, and evenly distributed, with nucleoli, single or multiple, usually prominent. The use of cytochemical and immunophenotypic studies classifies the remaining 30% of acute leukaemias that cannot be classified solely based on morphological features. Acute leukaemias are classified as nonlymphocytic/myeloid or lymphocytic based on the origin of the cells.

Acute myeloid leukemia

Acute myeloid leukaemia (AML) primarily affects older adults, with a median age at diagnosis of more than 65 years.[48-51]

In practise, however, age 60 or older is commonly used to define elderly AML[52,53]. Because of differences in disease-related factors (cytogenetics, secondary AML, and expression of the multidrug resistance phenotype) as well as patient-related factors, older age has a negative prognostic impact (i.e., general condition, organ dysfunctions, and comorbidities). Aside from these therapeutic disadvantages, the net incidence of elderly AML is expected to rise as the population ages, making elderly AML management an even more pressing issue.

The presence of ≥20% blasts in the peripheral blood or bone marrow is required for the diagnosis of AML; however, in some cases, the presence of recurrent cytogenetic abnormalities, such as the characteristic translocation (8;21), defines AML even at a lower blast count.[54]

Acute myeloid leukaemia (AML) is a cancer that develops from the neoplastic proliferation of a clone of myeloid cells and is distinguished by the uncoupling of proliferation and maturation. Myeloid blasts clonally expand in bone marrow, blood, or other tissues.

The WHO classification of acute leukaemias incorporates morphologic, immunophenotypic, genetic, and clinical features. The WHO classification of AML[55] is divided into following categories:

• Acute myeloid leukaemia with recurrent genetic abnormalities. • Acute myeloid leukaemia with myelodysplasia-related changes• Therapy-related myeloid neoplasms •AML, not otherwise specified • Myeloid sarcoma •Meloid proliferations associated with Down syndrome

The recommendation that the required blast percentage for a diagnosis of acute myeloid leukaemia be > 20% myeloblasts in the blood or marrow is a significant change from FAB classification.

Normocytic normochromic anaemia, neutropenia, and thrombocytopenia are seen on the blood film. Although the total white blood cell count (WBC) is typically elevated, some patients have normal or low WBC.

The bone marrow aspiration in AML is frequently a dry tap, and the bone marrow biopsy is usually hypercellular, with tightly packed cells and a few fat cells, but it can also be normocellular or hypocellular, with an increase in the number of blasts. Immature cells with round to oval nuclei and prominent nucleoli with pale blue cytoplasm infiltrate the marrow. In AML, bone marrow histology is frequently used as a secondary investigation. Because aspirate is usually hypocellular and has few circulating leukaemic cells, trephine biopsy may be required for diagnosis [56]

Positive stains include Myeloperoxidase and Sudan Black. The marrow is infiltrated by both blasts and monocytoid cells with a convoluted nucleus in myelomonocytic AML. The peripheral blood has monocytosis, whereas the bone marrow has more than 20% myeloblasts. Positive staining for peroxidase and nonspecific esterase. Promyelocytes appear as blast cells in tissue sections[57]

Acute lymphoblastic leukemia(ALL):

It is a disease caused by the proliferation of a neoplastic clone of immature lymphoid cells with the morphology of lymphoblasts in the bone marrow. About three-quarters of ALL cases are B lineage, and one-quarter are T lineage. In the WHO classification, B-lineage ALL has been combined with B-lineage lymphoblastic lymphoma, which was designated as precursor - B lymphoblastic leukaemia/lymphoma in the 2001 classification but as B lymphoblastic leukaemia/lymphoma in the 2008

classification, and further divided into 'not otherwise specified' and 'with recurrent genetic abnormalities'.[58]

ALL is uncommon in patients over the age of 60. ALL in such patients frequently has high-risk genetic alterations that lead to resistance to standard chemotherapy. Older patients frequently have comorbidities, making it difficult to treat them with the same zeal as younger patients. ALL in elderly patients aged 60 or older accounts for approximately 30% of ALL cases, excluding paediatric patients. [59] According to the Surveillance Epidemiology and End Results study, the incidence of ALL in elderly patients (65 years old) is 1.0 to 1.6 per 100,000 patients, which is significantly higher than in patients 25-54 years old (0.6 to 0.7 per 100,000). [60] Philadelphia chromosome (Ph) is common in older adults with ALL, accounting for approximately one-third of all cases. [61-63] Other unfavourable cytogenetics seen more frequently in older adults with ALL include t(8;14), complex karyotype, low hypodiploidy, and t(8;14) (14;18). [64] Furthermore, older adults with ALL are more likely to have harmful genetic alterations such as TP53 and IKZF1 mutations. [65]

ALL is distinguished clinically by bruising, pallor, bone pain, lymphadenopathy, hepatomegaly, and splenomegaly.

Peripheral blood smear of ALL contains leukaemic lymphoblasts, and the total white blood cell count (WBC) is usually elevated. There is also normocytic normochromic anaemia and thrombocytopenia.

Bone marrow cytology :

In ALL, marrow is hypercellular which is heavily infiltrated by leukaemic blasts. Normal haemopoietic cells are reduced in number but otherwise normal. Blast morphology varies and differs in L1,L2,L3. The granules are MPO stain negative and PAS positive.

The marrow is markedly hypercellular and is diffusely infiltrated by lymphoblasts, which replace the majority of the haemopoietic and fat cells.[66] The size of the infiltrating cells varies, but on average they are about twice the diameter of red blood cells, with a large nucleus and

minimal cytoplasm, finely stippled chromatin, and one or two small or medium-sized nucleoli.

Diagnostic Immunophenotype:

Multi-channel flow cytometry (MFC) immunophenotyping has become the standard procedure for ALL diagnosis and subclassification, and it has also been developed as a useful tool for the detection and monitoring of minimal residual disease.

Immunophenotype of B-lineage ALL:

The most important markers for diagnosis, differential diagnosis, and subclassification in B-lineage ALL are CD19, CD20, CD22, CD24, and CD79a. CD19, CD22 (membrane and cytoplasm), and CD79a are the earliest B-lineage markers. [67-69]

Immunophenotype of T-lineage ALL:

T-cell ALL accounts for approximately 25% of all adult ALL cases. CD1a, CD2, CD3 (membrane and cytoplasm), CD4, CD5, CD7, and CD8 are T-cell markers. CD2, CD5, and CD7 antigens are all markers of the most immature T-cell cells, but none of them are completely lineage-specific, so the unmistakable diagnosis of T-ALL is based on the presence of surface/cytoplasmic CD3. CD10 expression is common (25%) and nonspecific in T-ALL; CD34 and myeloid antigens CD13 and/or CD33 can also be expressed. [67,70]

Chronic lymphocytic leukaemia

Chronic lymphocytic leukaemia (CLL) is a monoclonal lymphoid cancer that causes a progressive buildup of small, mature, but functionally incompetent neoplastic lymphocytes in the peripheral blood, bone marrow, and lymphoid organs[71-72] .The median age at CLL diagnosis is 72 years, with roughly 70% of patients being 65 years old and 40% being 75 years old. CLL is uncommon in people under the age of 25. Caucasians and men are more likely to have CLL.[71] CLL's clinical course can be

unpredictable. More than half of CLL patients are diagnosed when they are young.

A uniform population of mature, small lymphocytes with round nuclei, clumped chromatin, scanty cytoplasm, and a regular cellular outline can be seen on the blood film. Broken cells, also known as smear cells or smudge cells, are distinguishing features but not pathognomonic. Anaemia and thrombocytopenia develop as the disease progresses.

Histology of the bone marrow:

The bone marrow is hypercellular and contains an increased number of monomorphic mature lymphocytes.

The marrow is mostly made up of small lymphocytes. These cells are slightly larger than a typical lymphocyte. The nuclei are characterised by coarsely clumped chromatin, insignificant nucleoli, minimal cytoplasm, and irregular nuclear contours. The sections also show a small number of prolymphocytes and para - immunoblasts. and other normal haemopoietic cells are diminished.

In CLL, examination of bone marrow trephine biopsy sections provides a useful prognostic indicator that is partially independent of clinical stage. Most investigators find that the outcomes in cases with a diffuse pattern (poor prognosis) and those with non-diffuse (nodular and interstitial) patterns (good prognosis) differ.[73]

Chronic myeloid leukaemia (CML):

CML is a myeloproliferative disease that starts in an abnormal pluripotent bone marrow stem cell and is always linked to the Philadelphia (Ph) chromosome and/or the BCR/ABL fusion gene. Chronic myeloid leukaemia (CML) becomes more common as people get older. The annual age-specific incidence rate rises from less than one per 100,000 under the age of 40 to five at the age of 65, and exceeds eleven in the octogenarians, with little variation worldwide[67-68]. As a result, more than half of all CML patients are over the age of 60[68]. Age has been well

described as a poor prognostic factor for survival [69-70]. Older patients with chronic CML have a worse performance status and live a shorter life than younger patients. [74-75]

Patients with anaemia, abdominal fullness, splenic discomfort or pain, or, in rare cases, features of leucostasis due to a high white blood cell count, may present (WBC). Physical examination reveals hepatomegaly and splenomegaly.

A peripheral blood smear reveals leucocytosis, with wbcs ranging between 20 and 500 10^9 /l. Neutrophils and myelocytes are the most common cell types in peripheral blood. Immature granulocytic cells are also present, with blasts and promyelocytes accounting for less than 10% - 15% of the cells. [76] Basophils increase, as does the absolute eosinophil count; eosinophil and basophil myelocytes increase. If nucleated red blood cells are present, the prognosis is poor. [77] Platelet count is usually normal or elevated.

The bone marrow is hypercellular, with an increase in granulocytes and their precursors, as well as megakaryocytes. The myeloid:erythroid ratio exceeds 10:1. Erythropoisis is reduced, but maturation is normal.

The marrow biopsy revealed hypercellularity and a loss of fat cells. Haemopoietic cells occupy more than 95% of the marrow cavity. Granulocytic precursors are increased with varying degrees of leftward shift. The topography of haemopoiesis is preserved, with granulopoiesis primarily occurring in the paratrabecular, peri-arteriolar, and pericapillary areas, though more mature granulocytic precursors extend into the central areas of intertrabecular marrow. Due to granule dissolution during processing, eosinophil precursors are increased but basophilis is not seen in biopsy. Megakaryocytes proliferate and form small clusters with abnormal nuclei or hypolobated nuclei. Mast cells and plasma cells are frequently seen in the perivascular space. Pseudo - Gaucher cells are also possible. Pseudo - Gaucher cells have been found in up to 30% of cases.

Fibrosis has been reported to range from 10% to 35% during the natural course of CML, depending on its definition, the stains used, and the time of evaluation during the course of CML.[78] Myelofibrosis has been identified as a warning sign in CML and an immediate precursor to blast crisis. [79-80] CML can undergo blast transformation, with approximately 70% of cases being myeloid and 30% being lymphoid in lineage. The detection of the lymphoid blast crisis is aided by measuring the levels of an enzyme known as terminal deoxynucleotidyl transferase (Tdt) produced by blast cells.

Polycythemia vera

Polycythemia vera occurs commonly in the 6th or 7th decade of life. A pluripotent stem cell capable of differentiating into red blood cells, granulocytes, and platelets is the primary defect. Clonality has been established using glucose-6-phosphate dehydrogenase studies and restriction fragment length polymorphism of the active X chromosome.PV erythroid precursors are extremely sensitive to erythropoietin, resulting in increased red blood cell production. Diagnosis of PV requires meeting either all 3 major criteria, or the first 2 major criteria and the minor criterion and the WHO criteria for diagnosing polycythemia vera is as follows: [55]

Major criteria

1. Hemoglobin >16.5 g/dL in men/ Hemoglobin >16.0 g/dL in women or Hematocrit >49% in men / Hematocrit >48% in women or increased red cell mass (RCM)
2. 2. BM biopsy showing hypercellularity for age with trilineage growth (panmyelosis) including prominent erythroid, granulocytic, and megakaryocytic proliferation with pleomorphic, mature megakaryocytes (differences in size)
3. 3. Presence of *JAK2*V617F or *JAK2* exon 12 mutation

Minor criterion

Subnormal serum erythropoietin level

Primary myelofibrosis (PMF)

PMF is characterised by clonal hematopoietic stem cell expansion in the bone marrow, as well as reactive nonclonal fibroblastic proliferation and marrow fibrosis. Extramedullary hematopoiesis (myeloid metaplasia) occurs in the liver and spleen as the bone marrow becomes fibrotic and normal hematopoiesis is no longer possible. Diagnosis of prePMF requires meeting all 3 major criteria, and at least 1 minor criterion [55]

Major criteria

1. Megakaryocytic proliferation and atypia, without reticulin fibrosis >grade 1, accompanied by increased age-adjusted BM cellularity, granulocytic proliferation, and often decreased erythropoiesis
2. 2. Not meeting the WHO criteria for *BCR-ABL1*$^{+}$ CML, PV, ET, myelodysplastic syndromes, or other myeloid neoplasms
3. 3. Presence of *JAK2*, *CALR*, or *MPL* mutation or in the absence of these mutations, presence of another clonal marker,‡ or absence of minor reactive BM reticulin fibrosis

Minor criteria

Presence of at least 1 of the following, confirmed in 2 consecutive determinations:

a. Anemia not attributed to a comorbid condition
b. Leukocytosis ≥11 × 10 ^{9}/L
c. Palpable splenomegaly
d. LDH increased to above upper normal limit of institutional reference range

Essential thrombocythemia (ET)

Essential thrombocythemia, is characterized by a sustained clonal proliferation of megakaryocytes in the bone marrow, with a peripheral blood platelet count greater than 450x 10^{9}/L. Diagnosis of ET requires

meeting all 4 major criteria or the first 3 major criteria and the minor criterion[55]

Major criteria

1. Platelet count ≥450 × 10^9/L
2. BM biopsy showing proliferation mainly of the megakaryocyte lineage with increased numbers of enlarged, mature megakaryocytes with hyperlobulated nuclei. No significant increase or left shift in neutrophil granulopoiesis or erythropoiesis and very rarely minor (grade 1) increase in reticulin fibers
3. Not meeting WHO criteria for *BCR-ABL1* CML, PV, PMF, myelodysplastic syndromes, or other myeloid neoplasms
4. Presence of *JAK2*, *CALR*, or *MPL* mutation

Minor criterion

Presence of a clonal marker or absence of evidence for reactive thrombocytosis

Myelodysplastic syndromes (MDS)

MDS are clonal haematopoietic stem cell diseases characterised by dysplasia and ineffective haematopoiesis in one or more of the major myeloid cell lines, with varying propensity to progress to acute myeloid leukaemia. A minimum of 20% myeloblasts in the blood or marrow is required for AML diagnosis. Myelodysplastic syndromes primarily affect older adults with a median age of 70 years, with a non-age corrected annual incidence of 35/100,000 people rising to more than 20/100,000 among those over the age of 70. [81-83] Cogle et al. [81,84] developed a claims-based algorithm to assess MDS incidence in the SEER-Medicare population and estimated an incidence of 75 cases per 100,000 persons over the age of 65, compared to the 20 cases per 100,000 previously reported by SEER alone, implying that the annual incidence in older adults is potentially three times higher.

MDS is diagnosed and subtyped based on blood and bone marrow analysis. MDS is distinguished by peripheral blood cytopenias affecting more than one or more cell lineages with cellular marrow. Cytopenias are defined as follows by WHO:

(a) Anemia (haemoglobin 10 g/dl) (b) Leucopenia (absolute neutrophil count 1.8 x 10^9/L) (c) Platelet count of 100 x 10^9/L, thrombocytopenia (d) Monocytes - The concentration of monocytes should be 1 x 10^9/L.

MDS is characterised by peripheral blood findings such as anaemia, neutropenia, and thrombocytopenia. Anemia is the most common symptom in approximately 85% of cases. A low reticulocyte count is usually associated with it. Red cell morphology is normocytic, macrocytic, or dimorphic, with normal folic acid and serum Vit. Bl2 levels. Basophilic stippling, Howell Jolly bodies, and megaloblastoid nucleated RBCs are common features of RBCs. Neutropenia is found in nearly half of all cases. Monocytosis, basophilia, eosinophilia, and lymphocytosis have been observed in some cases. Nuclear hypolobation (pseudo-Pelger-Huet) anomaly, ring nuclei, nuclear hypersegmentation, and irregular contour of neutrophil nuclei are all dyspoietic features. MDS is distinguished by the presence of two lobes of chromatin connected by a very thin strand of chromatin (Pince-nez nuclei). In 25-30% of cases, thrombocytopenia is present. Platelets can have hypogranular/agranular cytoplasm.[83]

MDS is classified by the WHO 2016 as follows[55]:

•MDS with single lineage dysplasia (MDS-SLD)

• MDS with multilineage dysplasia (MDS-MLD)

• MDS with ring sideroblasts (MDS-RS)

MDS-RS with single lineage dysplasia (MDS-RS-SLD)

MDS-RS with multilineage dysplasia (MDS-RS-MLD)

• MDS with isolated del(5q)

• MDS with excess blasts (MDS-EB)

MDS with excess blasts-1 (MDS-EB-1)

MDS with excess blasts-2 (MDS-EB-2)

• MDS, unclassifiable (MDS-U) with 1 % blood blasts

MDS-U with single lineage dysplasia and pancytopenia

MDS-U based on defining cytogenetic abnormality

• Refractory cytopenia of childhood

All three cell lines exhibit dysplastic changes in peripheral and bone marrow smears. Dyerythropoiesis is characterised by nuclear budding, internuclear bridging, karyorrhexis, multinuclearity, and megaloblastoid changes in RBCs. Vacuolization, ring sideroblasts, and PAS positivity are cytoplasmic features. Small size, hypolobation (pseudo Pelger-Huet), and hypersegmentation, hypogranularity, and pseudo Chediak-Higashi granules characterise WBC dysgranulopoiesis. Megakaryocyte dysplasia is distinguished by hypolobulated and non-lobulated nuclei in megakaryocytes of all sizes, as well as multiple widely separated nuclei.

A bone marrow biopsy is required in MDS because it reveals dysplastic maturation in all three elements. The normal marrow architecture has been distorted. Granulocytic cells from the paratrabecular area migrate to the central area. Instead of being in the central zone and near sinusoids, erythroid and megakaryocytes migrate to the paratrabecular region. The marrow can be hypocellular, normocellular, or hypercellular. MDS is distinguished by abnormal localization of immature precursors (ALIP), which is characterised by clusters of myeloblasts and promyelocytes (5-8cells) in the central portion of the marrow tissue. Therapy-related MDS occurs in patients who have received radiation therapy for both malignant and non-malignant conditions, as well as chemotherapy. [81,85]

Non- Hodgkin's lymphoma

Non- Hodgkin's lymphoma (NHL) incidence has been found to rise from 8% to 10% per year. More than half of new NHL cases in Europe and North America occur in patients over the age of 65. It has been highlighted

that this subset of patients presents with different characteristics and has a poorer outcome than their younger counterparts due to chronic or weakening associated diseases and age itself. [86-87] It is assumed that very elderly NHL patients, those over the age of 80, are more difficult to treat and require special care. The patient comes with complains of lymph node enlargement, severe or frequent infections, easy bruising or bleeding, and so on.[87]

Non- Hodgkin's lymphoma staging includes a bone marrow examination. The best method for detecting lymphoma involvement in the marrow is a bone marrow biopsy. Because lymphoma cells are more dense and adherent in bone marrow aspirates, they are less diagnostic. As a result, the volume of the biopsy is critical. Bilateral posterior iliac crest trephine biopsies have the advantage of doubling specimen size and allowing examination of specimens from different sites, and have resulted in more positive biopsy detection of the disease. In sections, approximately two-thirds of the marrows involved have a focal pattern of distribution along the paratrabecular region, while the other third have a diffuse pattern of distribution. Malignant cells have a small amount of cytoplasm and a regular round nucleus with coarse chromatin and indistinct nucleoli. Nuclear pleomorphism is minimal or absent.

Six major patterns are visible, either alone or in combination. Such patterns are useful in the differential diagnosis of lymphoproliferative disorders and can be prognostic. They are classified as interstitial, nodular, paratrabecular, random focal, intrasinusoidal, and diffuse.

The marrow involvement in Burkitt's lymphoma is widespread. The cells medium-sized,relatively uniform blast like cells with round nucstippled chromatin,visible but delicate nucleoli. Basophilic cytoplasm with clear vacuoles of varying sizes.[88] The cells are stained positively with methylgreen pyronine and oil red 'O,' but not with PAS. Chemotherapy,

either alone or in combination with radiation therapy, is one of the primary treatment options.

Hodgkin's lymphoma

Hodgkin's lymphoma in older patients is not a rare disease: according to US government epidemiological data, the age adjusted incidence for HL 65 in 2006-2008 was 17.7% of all HL[89]. Only about 5-10% of patients enrolled in clinical trials are over the age of 60. A bone marrow aspiration and biopsy are used to make the diagnosis. A trephine biopsy is required to diagnose Hodgkin's disease of the bone marrow.

Because of the focal nature of the infiltrate and the high incidence of fibrosis in Hodgkin's disease marrow infiltrates, the marrow aspirate is negative or inadequate for interpretation.

Because the pathology in the marrow indicates systemic disease and an unfavourable prognosis, bone marrow biopsy specimens are especially important in the staging of Hodgkin's disease. Patients with bone marrow involvement are more likely to have pancytopenia, which is a poor prognostic indicator. The identification of typical Reed-Sternberg cells or mononuclear variants in a Hodgkin's disease-specific cellular background, namely neutrophils and eosinophils, is used to make a diagnosis of bone marrow involvement. The bone marrow aspirate shows reactive changes and marrow is ogten hypercellular due to granulocytic hyperplasia. [90] The most common pattern is the diffuse pattern. Cellularity can range from sparsely cellular areas with predominant fibrosis to densely cellular marrows with a lymphocyte predominance. H&E staining is best suited for identifying R-S cells. If a typical R-S cell cannot be found, but mononuclear variants are present in a normal background, the biopsy is considered positive for Hodgkin's disease involvement. Sarcoid-like noncaseating epithelioid granulomas and benign lymphoid aggregates are two marrow lesions associated with Hodgkin's disease.

Treatment: The ABVD regimen (doxorubicin, bleomycin, vinblastine, and dacarbazine) has been considered the standard front-line treatment for HL patients[91] and remains the gold standard, particularly for patients with limited-stage HL.

Hairy cell leukaemia

Hairy cell leukaemia is a rare disease that accounts for 2% of all lymphoid leukaemias. Patients range in age from middle-aged to elderly, with a median age of 50. The gender ratio is 5:1. [92]

HCL is a B-cell lymphoproliferative disorder characterised by lymphoid cell proliferation with a small dense nucleus, moderate granular cytoplasm, and prominent cytoplasmic villous projections best seen with phase contrast and electron microscopy.

Clinical characteristics include: The most common symptoms are weakness and fatigue, fever, pain in the left upper quadrant, and bleeding. The majority of patients have splenomegaly and pancytopenia, with few circulating neoplastic cells. Monocytopenia is a common symptom. Other symptoms include hepatomegaly and recurrent opportunistic infections, while vasculitis, bleeding disorders, neurologic disorders, skeletal involvement, and other immune dysfunction are rare. [93]

HCL invariably involves bone marrow, and trephine biopsy is diagnostic. Aspiration may result in a dry tap due to the formation of reticulin fibres. The lymphoid cells are small and widely separated by an irregular zone of pale cytoplasm and reticulin mesh work that surrounds each cell. A BM biopsy is the most accurate way to make a diagnosis. The degree of BM effacement in HCL varies. In contrast to most other indolent lymphoid neoplasms involving the BM, the infiltrate is characterised by widely spaced lymphoid cells with oval or indented nuclei. The abundant cytoplasm and prominent cell borders may give the appearance of a "fried egg"[94-95]. Mitotic figures are almost non-existent. The involvement of the

bone marrow can be diffuse, focal, or interstitial. The primary pattern is interstitial or patchy, with some fat and haematopoietic elements preserved. CD103 is expressed in 60% of cases. Hairy cells also have the enzyme tartrate-resistant acid phosphatase (TRAP), which can be used to diagnose the disease.[94]

PLASMA CELL DYSCRASIAS

Plasma cell dyscrasias are a diverse group of diseases characterised by the expansion of monoclonal bone marrow plasma cells and the production of monoclonal immunoglobulin (M-component).[96]

These proteins, which can be detected in patients' serum or urine, are known as monoclonal proteins, M-proteins, M spikes, paraproteins, or immunoglobulinapathies. They are made up of two heavy chains of the same class and two light chains of kappa (κ) or lambda (λ). In some cases, plasma cells produce only free light chains (FLC), which are mostly detected in urine and are known as Bence-Jones proteins. [97]

Plasma cell neoplasms are classified as follows by the WHO 2016[98]:

1. Non IgM(plasma cell) monoclonal gammopathy of undeterminedsignificance (MGUS)
2. Plasma cell myeloma

Variants:

• Asymptomatic (smoldering) myeloma

• Non-secretory myeloma

• Plasma cell leukaemia

3. Plasmacytoma

• Solitary plasmacytoma of bone

• Extraosseous (extramedullary) plasmacytoma

4. Monoclonal immunoglobulin deposition diseases

• Primary amyloidosis

• Systemic light and heavy chain deposition diseases

5. Plasma cell neoplasms with associated paraneoplastic syndrome

• POEMS syndrome

• TEMPI syndrome(provisional)

Multiple myeloma

It is characterised by neoplastic proliferation of plasma cells and the production of a monoclonal Ig detectable in serum, urine, or both. With an increasing number of elderly people and better diagnostic methods, the incidence of myeloma is becoming more recognised, particularly in adults over the age of 60, and accounts for 15% of all hematologic malignancies in the United States. Thirty-five percent of patients are 75 or older when they are diagnosed. The disease is slightly more common in males than females, with a median age of presentation of around 70 years. In an elderly patient with bone pain and unexplained anaemia, especially rouleux formation on the peripheral blood smear, myeloma should be suspected. Typically, osteolytic lesions in the skull, ribs, sternum, vertebrae, and pelvis are present. Routine urine analysis and "dip stick" methods will not detect Bence-Jones protein, but sulfosalicylic acid and p-toluene sulfonic acid are effective screening agents. A monoclonal spike is not always indicative of multiple myeloma because approximately 1% to 3% of elderly people have monoclonal gammopathy but no myeloma develops. These are referred to as "benign" idiopathic monoclonal gammopathies because they have a monoclonal spike of less than 3 gramme per dl, less than 20% marrow plasma cells, no Bence-Jones proteinuria, and no visible bone destruction.

Diagnostic criteria for multiple myeloma revised by the International Myeloma Working Group in 2014[98]

Clonal bone marrow plasma cells >10% or biopsy-proven bony or extramedullary plasmacytoma and any one or more of the following myeloma defining events:

• Myeloma defining events:

- Evidence of end organ damage that can be attributed to the underlying plasma cell proliferative disorder, specifically:

- Hypercalcaemia: serum calcium > 0.25 mmol/L (> 1 mg/dL) higher than the upper limit of normal or > 2.75 mmol/L (> 11 mg/dL)

- Renal insufficiency: Creatinine clearance < 40 ml per minute or serum creatinine > 177 µmol/L (> 2'mgldl)

- Anaemia: hemoglobin value of > 20 g/L below the lower limit of normal, or a haemoglobin value of < 100 g/L

- Bone lesions: one or more osteolytic lesions on skeletal radiography, CT or PET

• Any one or more of the following biomarkers of malignancy:

Clonal bone marrow plasma cell percentage more than or equal to 60%

- Involved: uninvolved serum free light chain ratio more than or equal to 100.

- >1 focal lesions on MRI studies

Peripheral blood smear: The presence of the paraprotein in the blood causes normocytic normochromic anaemia, increased rouleaux formation, and increased background basophilic staining. In a few cases, there is a leucoerythroblastic picture.

Myeloma causes hypercellular to normocellular marrow involvement, with an increase in the percentage of plasma cells.

Myeloma cells infiltrate the bone marrow. Myeloma cells can be morphologically normal, with an eccentric nucleus, clumped chromatin, and Golgi zone, or they can be moderately or severely dysplastic. A common cytological abnormality is nucleocytoplasmic asynchrony, which occurs when the cytoplasm is mature but the nucleus has a diffuse chromatin pattern or a prominent nucleolus. Other cytological abnormalities include pleomorphism, increased cell size, a high N:C ratio, nuclear lobation, multinuclearity, myeloma cell phagocytosis, and the presence of mitotic figures. Extreme multinuclearity occurs infrequently, with up to 40 nuclei per cell. Haemosiderin is found in myeloma cells on occasion. Myeloma cells may contain a variety of intranuclear and intracytoplasmic inclusions. The Dutcher body is the most common intranuclear inclusion.

Plasma cell distribution in trephine sections can be focal, interstitial, diffuse, or a combination of these patterns. Diffuse involvement is typically associated with a more advanced clinical stage. Multiple myeloma is distinguished by the presence of homogeneous nodules of plasma cells in paratrabecular distribution, as well as osteoclastic activity and associated fibrosis. Plasma cells are classified into three types based on their morphology: mature, immature, and plasmablastic. The plasmablastic type is typically associated with an aggressive course of treatment. Based on the percentage of different types of plasma cells, multiple myeloma is classified as well, intermediate, or poorly differentiated.[99]

Plasma cell leukemia:

The term refers to plasma cell proliferation in the blood that exceeds 20% of leukocytes in the blood or an absolute plasma cell count that exceeds 20x109/cumm of blood. Plasma cells have replaced normal haematopoietic cells in the marrow.[96]

Solitary plasmacytoma:

A localised collection of plasma cells that occurs in either bone or soft tissue and is not associated with multiple myeloma or lymphoma. Microscopically, there is increased vascularity, with little stroma and sheets of plasma cells. Amyloid is thought to be present in 25% of lesions.

Waldenstrom's macroglobulinemia is a neoplastic clonal proliferation of IgM-secreting B-lymphocytes. Lymphocytes, plasmacytoid lymphocytes, and plasma cells can partially or completely replace bone marrow. Proteins are found intranuclear or intracytoplasmic PAS positive inclusions.

Monoclonal gammopathy of undetermined significance (MGUS): Serum monoclonal gammopathy affects about 1-2% of people over the age of 50, and 2-3% of people over the age of 65. With a mild or moderate degree of plasmacytosis, bone marrow may be normal. Plasma cells make up 10% of all nucleated cells in the bone marrow and have a normal morphology, clustering around blood vessels. Monoclonal spike of less than 3 g/dl, absence of Bence-Jones proteinuria, and no visible bone destruction.[96]

AMYLOIDOSIS

The marrow is involved in 30% of systemic amyloidosis, and patients are tested for Bence Jones proteins. It can manifest as either small focal lesions or extensive marrow replacement. Early on, focal medial amyloid deposits are seen in the media of the vessels, and later on, larger deposits are seen in the perivascular tissue and marrow substance. To confirm the diagnosis, Congo red staining is used.

METASTATIC TUMORS

Adults' most common tumours that spread to the marrow are carcinomas of the breast, prostate, lung, stomach, colon, kidney, and thyroid, though any tumour that causes blood-borne metastases may infiltrate the marrow. Sarcomas have a low rate of bone marrow involvement. Glioblastoma multiforme has been the most common type of bone marrow cancer reported, but metastatic medulloblastoma and oligodendroglioma have also been seen. Infiltration of the marrow may be suspected in the following circumstances: (I) bone pain; (ii) pathological fractures, lytic lesions, or sclerotic lesions seen radiologically; (iii) unexplained 'hot spots' on isotopic bone scans or positron emission tomography (PET) scanning; (iv) an abnormal magnetic resonance imaging scan; (v) hypercalcaemia or elevated serum alkaline phosphatase Although a leucoerythroblastic blood picture is a common feature of metastatic carcinoma to the bone marrow, it is not seen in all cases. The presence of leucoerythroblastic anaemia is associated with the degree of reactive bone marrow fi brosis rather than the extent of malignant infiltration. In detecting metastatic tumours, bone marrow aspiration and biopsy work in tandem. Metastatic carcinoma cells are larger in aspirate than all haematopoietic cells except megakaryocytes. They have a large nucleus with a prominent nucleolus and smudged, indistinct borders. Metastasis from carcinoma can be graded in biopsy sections based on the differentiation of the tumour cells. Columns of cells in a dense connective tissue stroma are seen in breast cancer metastasis. Melanin pigmentation may be present in malignant melanoma cells. Prostate cancer is typically poorly differentiated and lacks glandular arrangement. Metastatic tumours may be associated with marrow fibrosis.

LEISHMANIASIS

It is usually caused by Leishmania donovani infection, but in India it could be caused by L. tropica· Visceral leishmaniasis (VL) is a parasitic disease

transmitted by vectors that causes an immunoinflammatory response in macrophages in the reticuloendothelial system. [100-101] .

Leishmaniasis can result in normocytic normochromic anaemia, leucopenia, or pancytopenia, as well as increased rouleaux formation. Phagocytosed parasites are sometimes found in peripheral blood monocytes or neutrophils. Hypersplenism is visible.

A bone marrow aspirate is extremely helpful in diagnosing leishmaniasis. Macrophages have increased in number and contain organisms. These are distinguished by a small paranuclear basophilic body known as the kinetoplast, which gives the organism a distinctive 'double - dot' appearance. Leishmaniasis is typically associated with an increase in plasma cells, as well as dyserythropoiesis. There may be granuloma formation and an increase in macrophages that contain organisms in visceral leishmaniasis.[100]

Chandra H et al.(2019) [102] studied cases over 60 years of age constituted 156 of the total 721 bone marrow examinations performed during the study period, accounting for 21.6% of total cases. With a mean age of 66.2 5.03 years (median of 65) and a range of 60 to 84 years, the malefemale ratio was 1.7:1. Biopsies were not available in 10 of the 156 cases with bone marrow, either due to patient refusal or technical difficulty. In the geriatric population, the most common reason for a bone marrow examination was suspicion of lymphoma (18.5%), followed by cytopenia (17.3%). The most common diagnosis was normocellular marrow (24.3%), followed by nutritional anaemia (16.6%), which included iron deficiency anaemia, megaloblastic anaemia, or combined deficiency anaemia. The bone marrow aspirate in both cases was hemorrhagic, and trephine biopsy was not performed due to the patient's reluctance. There have been cases of aspirate and biopsy discordance. These findings indicate that diagnostic discordance occurred in 5.7% of total cases, with Non Hodgkin's lymphoma (NHL) being the most common diagnosis

missed on aspirate. In 13 of the cases, the aspirate was insufficient/haemorrhagic for diagnosis, while a biopsy was performed in one.

Gulati A et al (2017)[5]; A total of 83 bone marrow aspirations and 82 trephine biopsies, as well as peripheral blood smears and biopsy imprint smears, were examined. The majority of the patients (95%) were between the ages of 60 and 79, with a mean age of 61. Males made up 56% of the study population, with a male:female ratio of 1.3:1. Bone marrow examination was diagnostic or provided valuable clues for the diagnosis in 69 patients (83.2%). There were 65 haematological disorders and 4 non-hematological disorders among the 69 cases. Anemia was the most common condition, accounting for 29 (44.6%) of the cases, and dimorphic anaemia was the most common subtype (51.7%). The majority of dimorphic anaemia cases had megaloblastic and micronormoblastic erythropoiesis. Except for three cases of aplastic anaemia, which were diagnosed via biopsy, aspiration was diagnostic in all cases. There were 15 cases of multiple myeloma (23.1%) and 12 cases of non-Hodgkin lymphoma (NHL) infiltration (18.5%). There were five cases of small lymphocytic lymphoma and two each of lymphoplasmacytic lymphoma and diffuse follicular centre cell lymphoma among the NHL cases. Exact typing was not possible in three cases. Four (4.8%) cases of acute undifferentiated leukaemia, one case each of hairy cell leukaemia and chronic lymphocytic leukaemia, and three cases of myelofibrosis were also identified. There were four cases of non-hematologic disorders, three of which were metastatic deposits and one of which was an infestation with Leishmania donovani. Six cases of "dry tap" and five cases of blood tap were observed during bone marrow aspiration. All 11 of these cases required a bone marrow biopsy to be diagnosed. In 73 cases (86.9%), bone marrow aspiration findings correlated well with bone marrow biopsy findings. Biopsy was used to diagnose 11 cases of dry/blood tap on aspiration. Some of the patients with normal bone marrow studies

underwent the procedure for workup of NHL infiltration, PUO, or raised ESR.

M S Sulkashana, et al. (2015)[103] conducted the following research:
164 bone marrow examinations were performed over a 16-month period, with 50 patients being at least 60 years old. There were 27 men and 23 women among the patients, who ranged in age from 60 to 82 years. Only bone marrow aspirations were performed in 30 patients, while both aspiration and core biopsy were performed in 20 patients. In these patients, haemoglobin levels ranged from 3.0 to 10.6 g/dL, platelet counts ranged from 20,000 to 1.6 lac/L, 27 cases (54%) had nutritional anaemia (due to iron, Vitamin B12, and folic acid deficiency), 6 cases (12%) had myeloma, 3 cases (6%) had aplastic anaemia, 3 cases (6%) were diagnosed with chronic lymphocytic leukemia/lymphocytic leuk In this study, they discovered that plasma cell dyscrasias were the most common findings in bone marrow studies in elderly patients, following nutritional anaemia.
Manion EM, MD et al.(2021)[104] conducted a retrospective review of 119 bone marrow aspirates and biopsies from patients aged 85 and up. There were an equal number of men (65) and women (54), and the patients ranged in age from 85 to 99 years.
Biopsies were performed for a variety of reasons, including an unexplained decrease in one or more blood cell parameters (43 biopsies [36.1%]), thrombocytosis (10 biopsies [8.4%]), or leukocytosis (7 biopsies [5.9%]), follow-up of a previously diagnosed MDS or MDS-transformed AML (14 biopsies [11.8%]), suspicion of PCM (13 biopsies Of the 43 cytopenia biopsies performed, 23 were for a decrease in 2 cell lines or pancytopenia, 16 for anaemia, 3 for thrombocytopenia, and 1 for leukopenia.
With the exception of 40 biopsies performed for follow-up or staging of previously known diseases, 34 (43%) of 79 cases resulted in specific

diagnoses. Myelodysplasia was discovered in 11 patients, myeloproliferative neoplasms (MPNs) in 10, PCM in 5, lymphoproliferative disorders in 5, and acute leukaemia in 3. 13 (30%) of 43 cytopenia biopsies yielded specific diagnoses, and plasma cell dyscrasias were diagnosed in 5 of 13 patients who underwent PCM biopsy. MDS (11 patients) or AML were the diagnoses made in patients who underwent cytopenia biopsy (2 patients). 14 of the 17 biopsies for leukocytosis or thrombocytosis produced specific diagnoses, with thrombocytosis yielding 8 of 10 diagnoses and leukocytosis yielding 6 of 7 diagnoses. Patients with thrombocytosis were most commonly diagnosed with essential thrombocythemia or chronic idiopathic myelofibrosis, while patients with leukocytosis were diagnosed with a variety of acute and chronic leukaemias, including T-prolymphocytic leukaemia, chronic myelomonocytic leukaemia, chronic lymphocytic leukaemia, and acute myelogenous leukaemia.

Teke HU et al. (2021) [105] conducted a retrospective review of the BM aspiration/biopsy results of 114 patients aged 85 years who were followed-up by a university hospital's haematology department from 2010 to 2020. The patients were identified through the hospital's internal data handling system using the entry codes corresponding to BM aspiration and biopsy, and those aged 85 or older were identified. Demographic characteristics, primary diagnosis, any comorbidities, complete blood count (CBC) details, erythrocyte sedimentation rate (ESR), red blood cell indices, C-reactive protein (CRP), serum ferritin, vitamin B12, and folic acid levels, any abnormal serum biochemistry testing results, indications for and results of BM aspiration/biopsy, and treatments applied based on those results were all recorded for each patient, as were the rates and reasons for m There were 64.9% (n=74) males in their cohort of 114 patients with a mean age of 86.3+- 1.7 (85-93) years. During the BM aspiration and biopsy, none of the patients experienced any serious

complications. In our cohort, the first three indications for BM aspiration/biopsy were cytopenia in 48.2% (n=55), anaemia + elevated ESR in 18.4% (n=21), and leukocytosis + anaemia + thrombocytopenia in 15.8% (n=18). The results of BM aspiration/biopsy revealed a pathologic or hematologic diagnosis in 85.9% (n=98) and 78.9% (n=90) of patients, respectively. Myelodysplastic syndrome (MDS), acute myeloid leukaemia (AML), and multiple myeloma were the most common hematologic malignancies (MM).

Anand DR et al (2022) [106] conducted the following research:
The study was carried out over a 5-year period in the pathology laboratory of the Belgaum Institute of Medical Sciences in Belagavi, from January 1st, 2015 to December 31st, 2019. A total of 156 bone marrow examination cases over the age of 60 were reviewed and recorded. Anemia was the most common diagnosis (37%), followed by bicytopenia/pancytopenia (29%). In 17% of cases, there was a suspicion of leukaemia. The most common diagnosis was megaloblastic anaemia (39%). Iron deficiency anaemia and combined deficiency were found to be present in 14% and 8% of the cases, respectively. Acute leukaemia was found in 11 of the cases (7%). There were 10 cases (6%) of chronic myeloid leukaemia and 10 cases (6%) of normal bone study. Conclusion: Bone marrow aspiration and trephine biopsy are complementary diagnostic tools in the geriatric population for hematologic and non-hematologic disorders.

Maharjan D et al.(2021) [107] conducted the following research: From May 2018 to April 2019, this was a hospital-based, observational, cross-sectional study of elderly patients undergoing bone marrow examination at the department of pathology at Tribhuwan University Teaching Hospital. In these cases, the morphology of bone marrow aspiration and biopsy was studied and correlated with clinical and other ancillary laboratory test

parameters. Pancytopenia was the most common reason for a bone marrow examination (23.72%), followed by suspected plasma cell neoplasm (23%), and suspected acute leukaemia (16%). The most common neoplastic disorder was AML (15%), which was followed by myeloproliferative neoplasm (13.6%), myelodysplastic syndrome (10%), and multiple myeloma (8%). The most common non-neoplastic disorder was anaemia caused by renal failure (8%), followed by megaloblastic anaemia and anaemia caused by chronic inflammation (5% each).

Conclusion: Neoplastic disorders were more common than nonneoplastic and hematological malignancies were the most common diagnosis.

MATERIALS AND METHODS

SOURCE OF DATA

This was a 12 month prospective study (March 2021 to March 2022) conducted in the Department of Pathology, Dayanand Medical College and Hospital, Ludhiana.

METHOD OF COLLECTION OF DATA

Inclusion criteria:

The study included all the patients 60 years and above who underwent bone marrow examination (aspiration/ biopsy or both) along with hemogram, peripheral blood smears in the department.

Exclusion criteria:

Patients with age less than 60 years.

Patients in whom bone marrow examination was not done.

Methodology

1) Clinical history, examination and investigations of all identified cases was taken as per proforma.
2) Written informed consent was taken from all the patients.

Patient's age, sex, bone marrow indication, clinical history,relevant laboratory and radiological investigations along with bone marrow diagnosis was noted for every case.

Two ml of blood was collected in a vacutainer containing ethylene di-amine tetra acetic acid (EDTA) anticoagulant by venipuncture under aseptic precautions. Samples were processed by an automated autoanalyzer. Blood investigations were done.

- Total Leucocyte Count (TLC)
- Red blood Cell Count (RBC)
- Hemoglobin (Hb)
- Mean cell volume (MCV)
- Mean cell hemoglobin concentration (MCHC)
- Red cell distribution width (RDW)
- Platelet count
- Mean platelet volume (MPV)

Peripheral smears were stained using Giemsa stain.

Methods for Giemsa stain

- Air dried stains were fixed in methanol for 5-15 minutes.
- These were then flooded with buffered Giemsa stain (1 in 10 dilution)
- Kept for 15 minutes
- These were washed with buffered water and then dried.

Smears made were examined under microscope for-

RBC morphology- for morphological anemia, immature RBCs, nucleated RBCs and inclusions.

WBC morphology- for differential count, morphology of each cell, immature cells, platelet count and morphology for platelets.

Bone marrow aspiration

Jamshidi needle was used to aspirate material in all adults from posterior superior iliac crest /sternum. Local infiltration of anesthesia (2% lignocaine) was used after administering a test dose. Under aseptic conditions needle and stillete were placed in position and cap was closed. After piercing the skin and subcutaneous tissue, the periosteum and cortex were pierced with drilling action. Stillete was removed on entering

into the marrow cavity and 0.2-0.3 ml of marrow fluid was aspirated with sterile disposable 20 ml syringe. The aspirate was transferred to a set of slides and smeared. Needle was then withdrawn and a tincture benzoin seal was applied. Repeat aspirate was performed upon unsuccessful attempts of bone marrow aspiration. Slides were fixed with methanol for 15 minutes, dried and later stained with Giemsa stain (as already described)

Bone marrow aspirate was examined for

-Cellularity

-M: E ratio

-Erytropoiesis

-Myeopoiesis

-Megakaryopoiesis

-Differential count on bone marrow aspirate are – blasts, promyelocytes, myelocytes, metamyelocytes, neutrophils, basophils, eosinophils, basophils, plasma cells, lymphocytes, mast cells

Special stains i.e MPO (Myeloperoxidase) , Periodic Acid Schiff (PAS) , Reticulin, Masson's trichrome stain were done wherever required.

Myeloperoxidase (MPO) reaction

- Unfixed peripheral blood film/ bone marrow aspirate were covered with copper sulphate for 30 seconds
- This solution was drained.
- Cover with a solution containing saturated benzidine with 2 drops of 3% hydrogen peroxide for 2 minutes.
- Smear was washed thoroughly and dried.
- Result- Peroxidase positive granules stain bluish green.

Significance

Developing granulocytes give a positive peroxidase reaction. Auer rods in leukemic blasts give a positive reaction. The majority of mature neutrophils give a positive reaction. The main practical value of the reaction is in distinction between myeloblastic and lymphoblastic leukemia. The results are uniformly negative in mature and immature lymphocytes.

Periodic Acid Schiff (PAS) Reaction

The PAS reaction depends on the liberation of carbohydrate radicals from combination with proteins and their oxidation to aldehydes by Schiff's reagent. A positive reaction usually denotes the presence of glycogen.

Normally developing granules react positively at all stages of development.

Mature polymorphonuclear neutrophils reacts most strongly as their cytoplasm contains large amounts of stainable materials in the form of small granules.

Myeloblast and myelocytes contain fewer positively staining granules but theircytoplasm stains diffusely pale pink.

Lymphocytes normally contain a lesser staining material than granulocytes but a few fine or even coarse granules can be demonstrated,

Monocytes contain a small amount of fine scattered positive staining material. The erythroid precursors may stain by PAS as seen in cases of erythroleukemias.

Method

- Smears were fixed in methanol for 5-15 minutes and the washed in running tap water for 15 minutes.
- The slides were allowed to stand in Periodic Acid for 10 minutes and then washed.
- Then these were immersed in Schiff's reagent for 30 minutes.
- Rinsed three times in the rinsing solution.
- Washed in running water for 5 minutes and counter stained with Hematoxylin for 10 minutes.
- Finally the slides were washed with tap water and air dried.

Significance

In the lymphoblasts, blocks of staining material are present as seen in acute lymphoblastic leukemia. The erythroblasts may also react positively in erythroleukemias and in thalassemia.

Perls stain for iron stores was done in all cases. Air dry films of bone marrow fixed with methanol were placed in a solution of 10 g/l potassium ferrocyanide in 0.1 mol/l HCl made by mixing equal volumes of 47 mmol/l (20 g/l) potassium ferrocyanide and 0.2 mol/l HCl immediately before use. Slides were left in the solution for about 10 min at about 20 °C. after washing under running tap water for 20 min, slides were rinsed thoroughly in distilled water and then counterstain with 1 g/l aqueous neutral red or eosin for 10–15 s. Prepare the glassware by soaking in 3 mol/l HCl before washing.

Bone marrow biopsy

Under aseptic conditions and using anesthesia (2% lignocaine), biopsy was performed from posterior superior iliac crest along with bone marrow aspiration. Following aspiration the stilette was withdrawn from the needle and cap was closed. Now by rotatory movement needle was pushed in

further and then withdrawn in the reverse rotating direction. Contact smears were made by rolling the cylindrical marrow biopsy strip on the slide. Specimen was then fixed in 10% formalin overnight and decalcified in formic acid for 2hours. Then it was processed for paraffin blocking.

Procedure of Hematoxylin and Eosin Staining

•Slides were kept on hot plate in order to dewax the sections at temperature up to 60°C.

•Then slides were deparaffinised in xylene. Then hydration was done by passing through descending rates of alcohol to water. The slides were then stained in Harris Hematoxylin for 15 minutes.

• Sections were washed well in running tap water until sections turn blue. These sections were then differentiated in 1% acid alcohol (1% HCI in 70% alcohol) for 5-10 seconds, washed well in tap water till sections were again blue for 5 minutes or less. These were again stained in 1% Eosin for 10 min followed by washing in running tap water for 1-5 minutes.

Sections were dehydrated once again through ascending grades of alcohol, cleaned in Xylene and mounted with DPX (distyrenedibutylphtalate xylene) avoiding air bubbles.

• Stained slides were then subjected to microscopic examination under both low (100x) and high power (400x).

Reticulin stain was done in case of myelofibrosis and reactive fibrosis for grading and WHO grading system was used.

Reticulin stian

STEPS:

1. Deparaffinize

2. Wash with H20

3.25% Potassium permagnate for 2 minutes

4. Wash well with H20

5. Decolorize with 5% oxalic acid until section become clear

6. Wash with H20

7. Add ferric chloride

8. Give wilder bath for 1 minute

9. Wash with H20

10. Just dip in formalin (become black)

11. Place gold chloride for 10 minutes

12.Wash with H20

13.Place 5% sodium thiosulphate solution for 5 minutes

14.Wash with water

15.Counter stain with neutralred

RESULT:

Reticulin fibre- Black

Collagen-Pink

Immunophenotyping:

-Sample preparation for surface staining by Lyse wash method

12x75mm FACS tubes were labeled as per panel. 100 microliter of whole blood (1 million cells) was taken in each tube and then 20 microliter of antibody/antibody cocktail was added. Incubation in the dark was done at room temperature for 10-15 minutes. 2ml of BD FACS lyse was used and then again incubated in the dark at room temperature for 10-12 minutes and centrifuged at 200-300 g for 3-5 minutes. Supernatant was discarded. Cells were washed with sheath and 2ml of sheath fluid. Resuspension of cells in 0.5ml sheath or phosphate buffer solution with 2% paraformaldehyde was done.

-Sample preparation for simultaneous surface and intracellular staining

In two 12x75mm BD FACS tubes 100 microliter of whole blood. Pre titrated volume of surface antibody CD45 Per CP was added to both the tubes. Incubation for 10-15 minutes at room temperature in dark was done.1 ml FACS lyse (1x) was added and then incubated at room temperature in the dark. Centrifugation was done at 400g for 5 minutes. Supernatant was discarded.0.5 ml of permeabilization buffer was added and incubated in dark for 10 minutes. Cells were washed with sheath fluid and 1 ml of sheath fluid was added. Again centrifugation was done at 300g for 5 minutes and supernatant discarded. Pretitrated intracellular antibodies as per the label of the tube were added and incubated in dark at room temperature. Cells were washed again with sheath. 2ml of sheath was added and centrifuged at 200-300g for 3-5 minutes.

Supernatant was discarded. Resuspension in 0.5 ml of sheath or phosphate buffer solution with 1% formaldehyde (methanol free).

Cells were acquired on a pre-calibrated BD FACS Canto II (2 laser, 6color, 8 parameters) flow cytometer. FITC (Flurorescein Isothiacyanate), PE (R-Phycoerythrin), Per CP (Peridinin chlorophyll protein complex) and APC (Allophycocyanin) labelled antibodies were used.

Procedure for Immunohistochemical staining- Immunohistochemistry was done in few cases. Suitable blocks were chosen for IHC. Ventana Benchmark GX was used for immunohistohistochemistry. Methodology:

1. 2-3 um sections were cut and mounted on Poly-L-lysine coated slides. Slides were dried overnight at 37 degree C and dewaxed in xylene and hydrated.

2. Antigen retrieval procedure- The black box was filled 3/4th with citrate buffer and the slide carrier with slides was placed in it. The black box was placed in microwave for 9 mins.

3. Boiling of the solution was observed and the microwave was reset for 6 min and started.

4. The box was removed and cooled under tap water

5. Blocking endogenous peroxidase- Sections were incubated at room temperature in 0.3% H202 in methanol for 30-45 min and rinsed in running tap water for 5-10 mins and then dipped in distilled water for 1 min.

6. The slides were placed in Tris buffer [only one change for 5 min). 7. Blocking reagent was applied for 5-10 min and excess of it was wipped off.

8. Primary antibodies were applied covering the whole section and incubated at room temperature for 1 hour.

9. Slides were then washed in Triss buffer for 5 minutes.

10. Ultra Vision One HRP polymer covering the whole tissue was applied and incubated at room temperature for 45 mins.

11. Washing was done in TBS buffer [Tris buffer saline] for 5 min [4 changes].

12. One drop of substrate DAB [3, 3- Diaminobenzidine] solution was applied on each slide covering the whole material and incubated for 10- 15 mins, then washed in deiodinized water.

13. Hematoxylin was applied for few seconds and washed under running water.

14. Dry and dehydrate in alcohol and incubate for 2 mins.

15. Mounted in DPX [distyrenedibutyl phthalate xylene]

STATISTICAL ANALYSIS

Data was described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. All statistical calculations were done using SPSS (Statistical Package for the Social Science) SPSS 21 version statistical program for Microsoft Windows.

OBSERVATION & RESULTS

A prospective study was conducted on geriatric patients for a period of one year from March 2021 to March, 2022 in Pathology Department, DMCH , Ludhiana. This study included a total of 206 cases in which bone marrow aspiration and biopsy were performed simultaneously in patients of suspected hematological and non hematological diseases involving the marrow. In addition, ancillary techniques like flow cytometry, cytogenetic analysis, microbiological investigations etc. were also performed wherever necessary.

Age and Gender:

This study was conducted in geriatric patients of 60 and above 60 years of age. Out of 206 cases , majority (n=130,63%) were in 7th decade, 56 cases(27%) were in 8th and 20 cases (10%) in 9th decade. Male preponderance was noted with Male:Female ratio of 1.6:1

Table 1: Age wise distribution of all cases(n=206)

Age group	**No. of cases**	**%age**
60-70	130	63%
70-80	56	27%
> 80	20	10%
Total	206	100%

Table 2: Gender wise distribution of all cases(n=206)

	No. of cases	**%age**
Male	128	62%
Female	78	38%
Total	206	100%

Clinical features

In this study group, the most common clinical feature was generalized weakness in 151 cases(73.3%), followed by fever in 49 cases(23.7%), backache in 16 cases(7.7%) and pain abdomen in 15 cases(7.25%). Among the physical findings, splenomegaly was seen in 19 cases(9%) , hepatomegaly in 16 cases(8%) and hepatosplenomegaly in 10 cases(5%).

Hematological parameters:

Hematological parameters analysed in the subjects showed a wide range of distribution. Hemoglobin levels varied from 4.0 to 18.1 g/dl. The lowest level of 4.0g/dl was seen in a case of megaloblastic anemia and highest level of 18.1g/dl was recorded in a patient with myeloproliferative neoplasm. Most of the subjects had white cell count of more than 11000/mm3(61cases ,29.6%)and 33 cases(16.0%) had <2000/mm^3.Most of the patients had a platelet count of less than 150000/mm3(107cases,59.9%) . Lowest platelet count of 4000/mm3 was reported in a patient of metastasis of tumor to bone marrow.

Table 3: Hematological parameters of all cases (n=206)

		No. of cases	**%age**
Hb g/dl	>12	25	12.10%
	8.1-11.9	98	47.50%
	5.1-8.0	75	36.40%
	≤ 5	8	3.80%
TLC x10^9/L	> 20	28	13.59%
	15.1-20.0	16	7.77%
	10.1-15.0	29	14.08%
	4-10.0	85	41.26%
	3.1-4	12	5.83%
	2.1-3	11	5.34%
	< 2	25	12.14%

PLT x10^3/ul	< 150	101	49.03%
	150-450	72	34.95%
	>450	20	9.71%

Distribution of all cases according to clinical indications (n=206)

The most common clinical indication for bone marrow examination in geriatric patients was Plasma cell dyscrasia/ Multiple myeloma (23%) followed by pancytopenia (17%) and least common was hairy cell leukemia(0.4%) [Table 4].

Table 4: Distribution of all cases according to clinical indications (n=206)

	No. of cases	**%age**
Plasma cell dyscrasia/ Multiple myeloma	48	23%
Pancytopenia	36	17%
ITP/Thrombocytopenia	29	14%
Bicytopenia	13	6%
Chronic lymphocytic leukemia	13	6%
Anemia under evaluation	12	6%
Myeloproliferative neoplasm	8	4%
Acute Leukemia	8	3%

Pyrexia of unknown origin	4	2%
Chronic myeloid leukemia	3	1%
Polycythemia vera	3	1%
Myelodysplastic syndrome	3	1%
Lymphoproliferative disorder	2	1%
Thrombocytosis	2	1%
Hypereosinophilic syndrome	2	1%
Marrow infiltrative disorder / Metastasis	2	1%
Macrophage activation syndrome	2	1%
Hairy Cell Leukemia	1	0.4%

Of the total 206 cases in which bone marrow aspiration and biopsy was done, majority were diagnosed as Plasma cell neoplasm (18.9%) followed by myeloproliferative neoplasm (12.10%) among neoplastic cases. In noneoplastic category Idiopathic thrombocytopenic purpura (13.5%) was commonest diagnostic entity (13.5%)

Table 5: Distribution of all cases according to bone marrow diagnosis(n=206)

Neoplastic(n=116)	Plasma cell neoplasm	37	18.90%
	Myeloproliferative neoplasm	25	12.10%
	Lymphoproliferative neoplasm	22	10.60%
	Acute leukemia	16	7.70%
	Myelodysplastic syndrome	12	5.80%
	Metastasis	3	1.40%
	Chronic myelomonocytic leukemia	1	0.4%
Non –Neoplastic(n=90)	Idiopathic thrombocytopenic purpura	28	13.5%
	Megaloblastic anemia	11	5.30%
	Anemia of chronic disorder	9	4.30%
	Aplastic anemia	8	3.80%
	Hemophagocytic lymphohistiocytosis	6	2.90%
	Leukomoid reaction	5	2.40%

	Hemolytic anemia	4	1.80%
	Dual deficiency anemia	2	0.90%
	Hypereosinophilic syndrome	2	0.90%
	Iron deficiency anemia	1	0.40%
	Leishmaniasis	1	0.40%
	Granulomatous inflammation	1	0.40%
	Red cell aplasia	1	0.40%
	Normocellular normoblastic marrow	11	5.3%

NEOPLASTIC CASES

PLASMA CELL NEOPLASMS

Of the 37 cases of plasma cell neoplasm, majority of the cases were of multiple myeloma (n=34) (16.5%).

Multiple myeloma (n=34)

Majority of these patients were in the age group of 60 -70 years(76.5%) with M:F=1.1:1. Clinically most common presentation was generalized body weakness (61.8%) followed by backache(47.1%), fever (14.7%), loss of appetite (8.8%) , loss of weight (8.8%), bleeding manifestations (5.9%) and renal failure (5.9%). On physical examination pallor was seen in 6 patients(17.6%) and hepatomegaly was seen in 5 patients(14.7%).

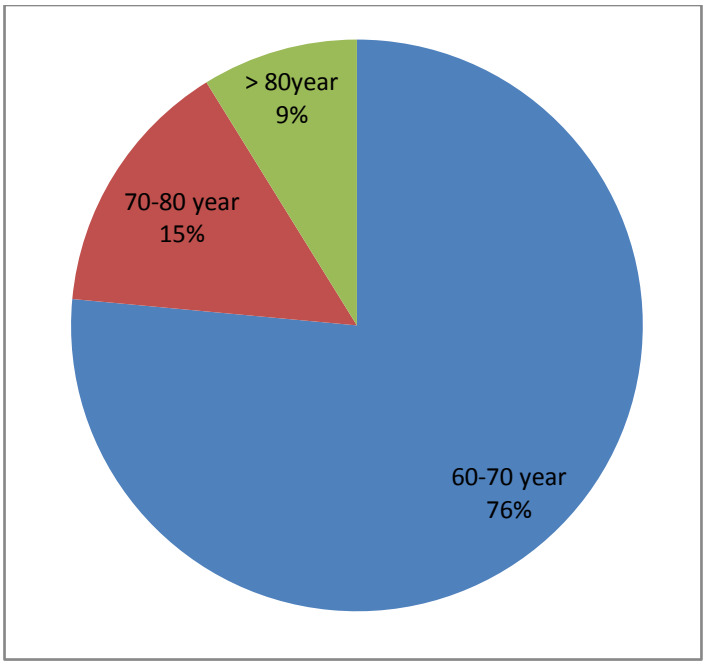


Figure 1: Age wise distribution of cases of multiple myeloma (n=34)

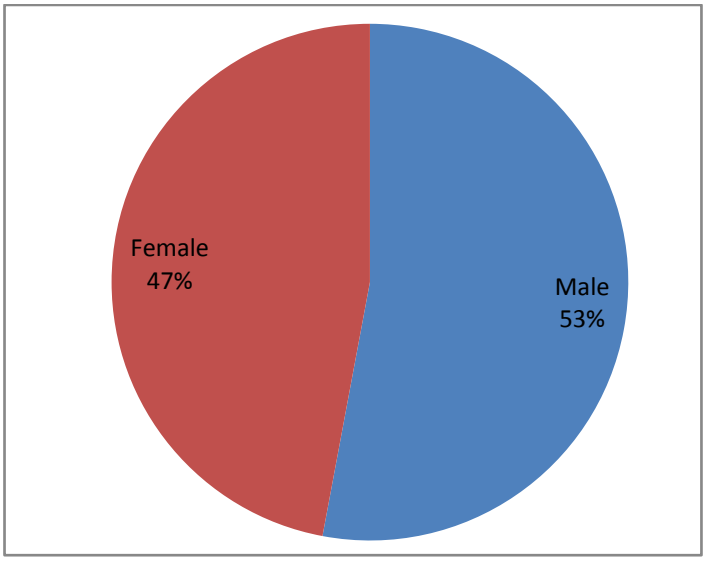


Figure 2 : Gender wise distribution of cases ofmultiple myeloma (n=34)

On peripheral smear normocytic normochromic anemia was seen in majority of these cases (n=33 cases,99.5%) and rouleaux formation was noted only in 7 cases (20.59%). Only in one patient peripheral plasma cells (25%) were noted while in others there were no plasma cells seen in peripheral smear. In these patients haemoglobin ranged from 4.7 to 12.9 g/dL and TLC was within normal limits in 26 cases (76.47%) while leucocytosis was seen in 8 cases (23.52%). Platelets were normal in majority of the cases while thrombocytopenia was seen only in 7 cases(20.5%). Serum creatinine levels were raised in 10 patients (29.4%) with a mean 3.4mg/dl. Calcium levels were raised in 14 patients (41.1%) with a mean 14.2mg/dl. On MRI scan , multiple osteolytic lesions in flat bones were observed in 12 cases (35.2%).

Table 6: Hematological parameters in patients of multiple myeloma (n=34)

		No. of cases	**%age**
Hb g/dl	>12	1	2.94%
	8.1-11.9	23	67.65%
	5.1-8.0	10	29.41%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	0	0.00%
	15.1-20.0	4	11.76%
	10.1-15.0	4	11.76%
	4-10.0	26	76.47%
	3.1-4	0	0.00%

	2.1-3	0	0.00%
	< 2	0	0.00%
PLT x10^3/ul	< 150x10^3	7	20.59%
	150-450	25	73.53%
	>450	2	5.88%

Bone marrow aspirates of majority of the cases were hypercellular (n=27,79.4%) while normocellular marrow was seen in 7 cases (20.5%). Interstitial pattern of distribution of plasma cells on biopsy was seen in majority of the cases i.e 15 cases (38.5%) which was followed by mixed pattern in 10 cases(25.6%) , diffuse pattern in 8 cases (20.5%) and nodular pattern in 1case (2.6%). The cases which had diffuse pattern of plasma cells on bone marrow biopsy, also had 30-60% plasma cells in bone marrow aspirate.

Table 7: Number of plasma cells/100 nucleated cells in cases of multiple myeloma (n=34)

Number of Plasma cells/100 nucleated cells	No. of cases	%age
10- 30%	10	29.4%
30-60%	8	23.5%
> 60%	16	47.1%

Table 8 : Bone marrow biopsy findings in cases of multiple myeloma (n=34)

Pattern of distribution of plasma cells	No. of cases	%age
Interstitial	15	38.5%
Mixed	10	25.6%
Diffuse	8	20.5%
Nodular	1	2.6%

Serum protein electrophoresis was performed in 25 cases(73.5%) of multiple myeloma while it was not available in 9 cases. In all these 25 cases (73.5%) M band was detectable on serum protein electrophoresis and majority were identified on immunofixation electrophoresis as IgG kappa (n=23,92%) while IgA kappa was seen in only one case. Diagnosis in the other 9 cases were made on the basis of bone marrow aspiration and bone marrow biopsy findings, where plasma cells were found to be >60% out of all the nucleated cells.

Monoclonal gammopathy of undetermined significance (MGUS) (n=2)

MGUS was observed in 2 male patients aged 84 and 85 years respectively who presented with generalized weakness and bony pain. On peripheral smear both patients had normocytic normochromic anemia while TLC and platelets were adequate. Serum creatinine and serum calcium levels were within normal limits in both cases. MRI scan was available in 1 case but no bony lesions was identified. Bone marrow aspirate smears in 1 case were hypercellular while in other were normocellular . Plasma cells were less than 10% in both cases. In both cases M spike was seen by immunofixation electrophoresis as IgG Kappa

monoclonal gammopathy . Serum M protein levels were less than 3g/dl in both cases.

Also seem a case of 64 year old, male presented with generalized weakness and drowsiness. On peripheral blood smear examination, normocytic normochromic anemia was observed with presence of plasma cells which constitute 25% of all leucocytes. TLC was within normal limits but had thrombocytopenia. Bone marrow aspirate smears of this patient were hypercellular with increased number of plasma cells which constitute 95% of all nucleated cells, along with presence of plasmablasts while all other normal hematopoietic elements were markedly depressed. Bone marrow biopsy also showed similar features and diagnosis of plasma cell leukemia were made.

MYELOPROLIFERATIVE NEOPLASM

In our study, 24 cases were diagnosed with MPN with male to female ratio of 2.4:1. Most cases were of chronic myeloid leukemia (45.8%) followed by essential thrombocythemia (25%), myelofibrosis(20%) and polycythemia vera (8.3%). According to age wise distribution, MPN was seen most commonly in the age group of 60 -70years(56%). Clinically, most common presentation was generalized weakness (84%) followed by fever(28%), loss of weight (8%) and shortness of breath (4%). The distribution of the cases are given in table 11:-

Table 9 : Distribution of the cases of MPN (n=24)

	No. of Cases	%age	Male:female
Chronic myeloid leukemia	11	45.8%	2.5:1
Essential thrombocythemia	6	25.0%	3:1
Myelofibrosis	5	20.0%	3:2
Polycythemia vera	2	8.3%	1:0

Table 10 : Age wise distribution of MPN cases(n=24)

Age group	No. of cases	%age
60-70	14	56.0%
70-80	9	36.0%
> 80	2	8.0%

Table 11 : Gender wise distribution of MPN cases(n=24)

Gender	No. of cases	%age
Male	17	70.8%
Female	7	29.2%

Table 12 : Clinical presentation in patients of MPN cases(n=24)

	No. of cases	%age
Weakness	21	84.0%
Fever	7	28.0%
Loss of weight	2	8.0%
Loose stool	2	8.0%
Shortness of breath	1	4.0%

Chronic myeloid leukemia (n=11)

There were 11 cases of chronic myeloid leukemia with a male to female ratio of 2.6:1. Most of the cases were in the age group of 60 -70 years(54.5%) and in these subjects, the most common clinical presentation were generalized weakness (80%) followed by fever (18%) and loss of weight (8%). Hepatosplenomegaly was seen only in 2 cases(18.18%)

Table 13 : Age wise distribution of CML cases(n=11)

Age group	No. of cases	%age
60-70	6	54.5%
70-80	4	36.3%
> 80	1	9.0%

Table 14 : Gender wise distribution of CML cases(n=11)

Gender	No. of cases	%age
Male	8	72.7%
Female	3	27.2%

On peripheral blood smear examination, severe anemia was seen in 2 cases(18.18%) while mild to moderate anemia was seen in 8 cases (72.7%) . Majority of these patients had microcytic hypochromic picture red blood cell picture (n=6 cases ,54.5%) while others showed normocytic normochromic red blood cell picture. In all these cases leucocytosis with shift to left upto blast stage was noted and in 5 cases basophils (1-2%) was observed on peripheral blood smear. Platelets were adequate in most cases (81.8%). LAP score was available in 3 cases in which score was within normal limits.

Table 15: Hematological parameters in CML patients (n=11)

		No. of cases	%age
Hb g/dl	>12	3	27.27%
	8.1-11.9	6	54.55%
	5.1-8.0	2	18.18%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	11	100%
	15.1-20.0	0	0.00%
	10.1-15.0	0	0.00%
	4-10.0	0	0.00%
	3.1-4	0	0.00%

	2.1-3	0	0.00%
	< 2	0	0.00%
PLT x10^3/ul	< 150x10^3	0	0.00%
	150-450	9	81.8%
	>450	2	18.18%

Bone marrow aspiration smears and biopsy of all these cases showed hypercellular marrow. In all the cases erythroid precursors were depressed and myeloid precursors showed myeloid hyperplasia. Megakaryocytic hyperplasia with dwarf forms were seen in all these cases ,with M:E ratio being 6:1 to 15:1. There were no prominence of blasts seen in any of these cases.

Essential thrombocythemia (n= 6)

There were 6 cases of essential thrombocythemia with male to female ratio of 1:1 . Most of the cases were in age group 60 -70 years(50.0%) followed by 70-80 years (33%) and >80 year (17%).The most common presentation of these patients were generalized weakness which was seen in 66.7% cases, followed by fever in 6.7% cases and loose stool in 16.7% cases. Spleenomegaly was seen only in one case(16.7%).

Table 16 : Signs and symptoms in patients of essential thrombocythemia (n=6)

	No. of cases	**%age**
Weakness	4	66.7%
Loose stools	1	16.7%
Fever	1	16.7%

On peripheral blood smear anemia was seen in 4 cases(66.67%), while thrombocytosis in all the cases. TLC was within normal limits in all these cases. Bone marrow aspirates and biopsy of all the cases were hypercellular. In the erythroid series, normoblastic maturation was seen in 66.6%, while erythroid prominence was seen in 33.3% cases. Myeloid prominence was seen in only 1 case (16.6%) while in others, myeloid precursors showed orderly cell maturation. Megakaryocytic hyperplasia with hyperlobated and hypolobated forms were seen in all these cases.

Table 17: Hematological parameters in essential thrombocythemia (n=6)

		No. of cases	%age
Hb g/dl	>12	2	33.33%
	8.1-11.9	4	66.67%
	5.1-8.0	0	0.00%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	0	0.00%
	15.1-20.0	0	0.00%
	10.1-15.0	0	0.00%
	4-10.0	6	100.00%
	3.1-4	0	0.00%
	2.1-3	0	0.00%
	< 2	0	0.00%
PLT x10^3/ul	< 150x10^3	0	0.00%
	150-450	0	0.00%

	>450	6	100.00%

All the cases of essential thrombocythemia on bone marrow aspiration and bone marrow biopsy showed hypercellular marrow which exhibited megakaryotic hyperplasia with presence of hyperlobated and hypolobated forms in all 6 cases. Erythroid precursors showed normboblastic maturataion in most cases and myeloid precursors showed orderly cell maturation. In 4 cases(66.67%), JAK2-V617F mutation was detected while in others not detected.

Table 18 : Bone marrow aspiration and biopsy findings in essential thrombocythemia cases(n=6)

		Cases	**%age**
Cellularity	Hypercellular marrow	6	100%
Erythropoisis	Normoblastic maturation	4	66.6%
	Erythroid prominence with normoblastic maturation	2	33.3%
Leucopoisis	Orderly cell maturation	5	83.3%
	Myeloid prominence with orderly cell maturation	1	16.6%
Megakaryocytes	Hyperplasia with hyperlobated & hypolobated forms	6	100%

Myelofibrosis (n=5)

There were 5 cases of myelofibrosis with male to female ratio of 4:1. Most of the cases were in the age group of 70 -80 years (60%), followed by 60-70 years (20%) and >80 years (20%). The most common presentation

was generalized weakness (100%) followed by fever (50%) and pain (33.3%). Hepatosplenomegaly was seen in one case(16.5%)

Table 19 : Clinical presentation in patients of myelofibrosis (n=5)

	No. of cases	%age
Weakness	5	100.0%
Fever	3	50.0%
Pain	2	33.3%
Hepatosplenomegaly	1	16.7%

On peripheral blood smear examination, microcytic hypochromic anemia was seen in most cases (80%) with presence of nucleated RBS in 3 cases (60%). Leucocytosis was seen in 2 cases (40%) whereas leucopenia was seen in 2 other cases (40%). Out of all, thrombocytosis was seen in 3 cases (60%) while thrombocytopenia was noted in 2 cases (40%).

Table 20: Hematological parameters in myelofibrosis cases(n=5)

		No. of cases	%age
Hb g/dl	>12	0	0.00%
	8.1-11.9	3	60.00%
	5.1-8.0	2	40.00%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	1	20.00%
	15.1-20.0	1	20.00%
	10.1-15.0	0	0.00%

	4-10.0	0	0.00%
	3.1-4	1	20.00%
	2.1-3	1	20.00%
	< 2	1	20.00%
PLT x10^3/ul	< 150x10^3	2	40.00%
	150-450	0	0.00%
	>450	3	60.00%

In all these cases dry tap was obtained on aspirate. On bone marrow biopsy, marrow was hypercellularin 3 cases (60%) while 2 cases (40%) had normocellular marrow. Megakaryocytic prominence was seen in all cases with focal clustering and presence of both hyperlobated and hypolobated forms. Bone marrow fibrosis was noted in all these cases and on reticulin and masson's stain, grade 2 fibrosis was seen in 3 cases and grade 3 fibrosis was seen in 2 cases. out of 5 cases, JAK2-V617F mutation was detected in 3 cases and in 1 case MPL mutation was detected while in the remaining 1 case, no mutation was detected.

Polycythemia-vera : There were 2 male patients who were 65 and 63 year old. They presented with pruritis and generalized weakness. On peripheral blood smear, hemoglobin was high in both cases (17.6 and 17.4 g/dL) respectively. TLC was raised in one case while in other it was within normal limits and platelet count was within normal limits in both cases. Serum erythropoietin levels were below 4.1mU/ml. Aspirates of both cases were hypercellular and trilineage hyperplasia was noted. All these cases had pleomorphic megakaryocytes, few of which had hypolobation and few had hyperlobation of nucleus. Bone marrow biopsy section showed the same features.Out of two cases one case showed

mutation in JAK2-V617F while in other no cytogenetics was performed. Keeping in view of both peripheral and bone marrow findings, the diagnosis of polycythemia vera was given.

LYMPHOPROLIFERATIVE NEOPLASM

There were 23 cases of lymphoproliferative neoplasm with male to female ratio of 1.8:1. Most of the cases were of chronic lymphocytic leukemia (n=13) followed by non hodgkin's lymphoma (n=4), lymphoplasmacytic lymphoma (n=3), hairy cell leukemia (n=2), classical Hodgkin lymphoma(n=1) and marginal zone lymphoma (n=1). Most of the cases were in age group of 60 -70 years (58.0%).

Table 21: Distribution of cases of lymphoproliferative neoplasm (n=23)

	No. of cases	%age
Chronic lymphocytic leukemia	12	52.1%
Non Hodgkin's lymphoma	4	17.4%
Lymphoplasmacytic lymphoma	3	13.0%
Hairy cell leukemia	2	8.7%
Classical Hodgkin lymphoma	1	4.3%
Marginal zone lymphoma	1	4.3%
Total	23	100.0%

Table 22: Age wise distribution of lymphoproliferative neoplasm cases(n=23)

Age group	**No. of cases**	**%age**
60-70	14	58%
70-80	5	21%
> 80	4	17%

Table 23 : Gender wise distribution of lymphoproliferative neoplasm cases(n=23)

Gender	**No. of cases**	**%age**
Female	8	33%
Male	15	63%

Out of total 23 cases of lymphoproliferative neoplasm, anemia was seen in majority of the cases (91.3%). Leucocytosis was seen in all cases.Thrombocytopenia was seen in 12 cases (52.17%) while it was within normal limits in 10 cases (43.48%) and thrombocytosis was seen in only 1 case (4.35%)

Table 24: Hematological parameters in lymphoproliferative neoplasm cases(n=23)

		No. of cases	**%age**
Hb g/dl	>12	2	8.70%
	8.1-11.9	13	56.52%
	5.1-8.0	7	30.43%
	≤ 5	1	4.35%
TLC x10^9/L	> 20	13	56.2%

	15.1-20.0	7	30.4%
	10.1-15.0	3	13.0%
	4-10.0	0	0.00%
	3.1-4	0	0.00%
	2.1-3	0	0.00%
	< 2	0	0.00%
PLT x10^3/ul	< 150x10^3	12	52.17%
	150-450	10	43.48%
	>450	1	4.35%

Chronic lymphocytic leukemia (n=12)

Out of 23 cases, 13 cases(56.5%) were diagnosed as CLL and male to female ratio among these cases was 1.7:1. These patients presented with weakness (75%) and loss of weight (16.6%). Spleenomegaly was seen in two cases (15.4%).

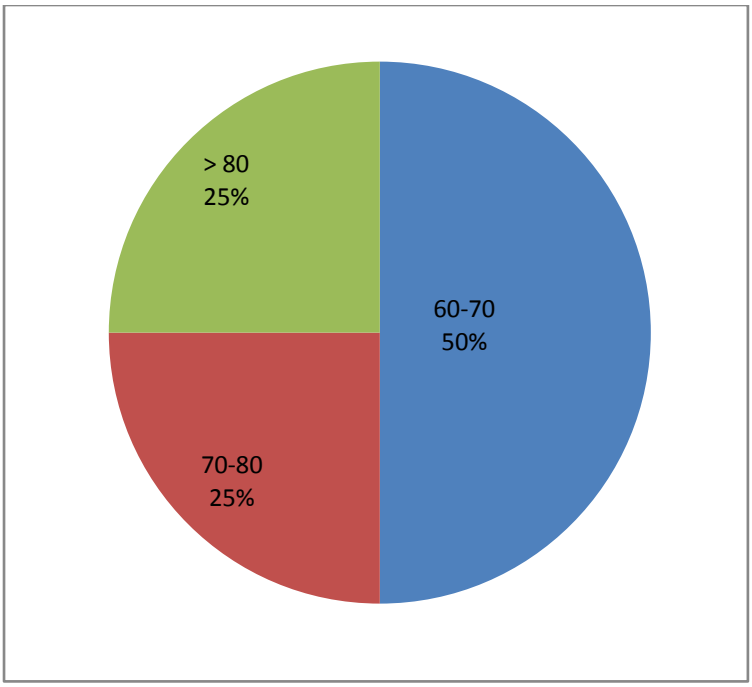


Figure 3: Age wise distribution of CLL cases (n=12)

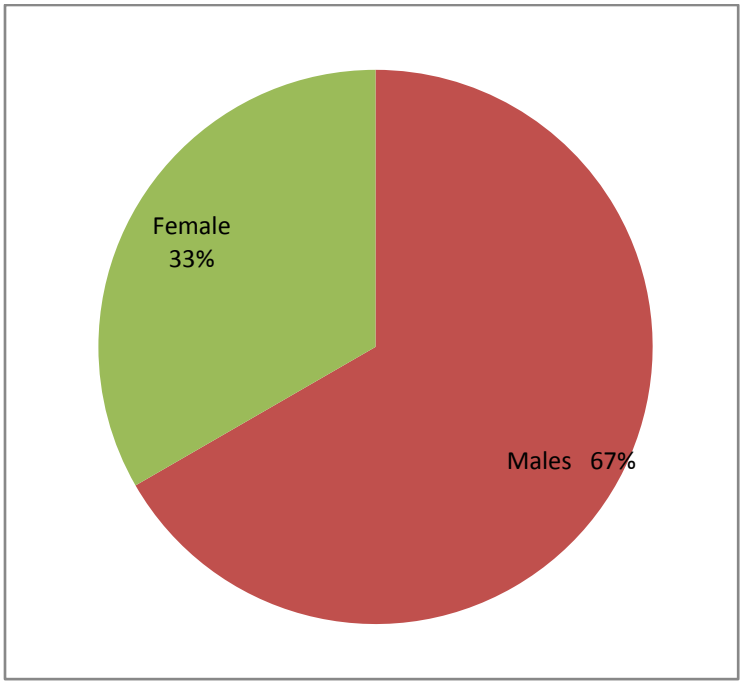


Figure 4: Gender wise distribution of CLL cases (n=12)

Table 25 : Clinical presentation in patients of CLL(n=12)

Signs & symptoms	No. of cases	%age
Weakness	9	75%
Pallor	3	25%
Loss of weight	2	16.6%
Splenomegaly	2	16.6%

On peripheral smears, normocytic normochromic anemia and leukocytosis with lymphocytosis and smudge cells were seen in all these cases. Platelets were within normal limits in most of the cases (66.67%) while in remaining cases thrombocytopenia was seen (33.33%)

Table 26: Hematological parameters in CLL cases (n=12)

		No. of cases	%age
Hb g/dl	>12	1	8.33%
	8.1-11.9	4	33.33%
	5.1-8.0	4	33.33%
	≤ 5	2	16.67%
TLC x10^9/L	> 20	9	75.00%
	15.1-20.0	0	0.00%
	10.1-15.0	2	16.67%
	4-10.0	0	0.00%
	3.1-4	0	0.00%

	2.1-3	0	0.00%
	< 2	1	8.33%
PLT x10^3/ul	< 150x10^3	4	33.33%
	150-450	8	66.67%
	>450	0	0.00%

Bone marrow aspirate smears of all these cases were hypercellular along with presence of sheets of mature lymphocytes while all other hematopoetic elements were depressed. Bone marrow biopsy showed similar findings with lymphoid cells arranged in different patterns as described in table (27):

Table 27 : Bone marrow biopsy findings in patients of CLL (n=12)

Pattern of distribution of lymphoid cells	**No. of cases**	**%age**
Mixed	4	33.3%
Diffuse	3	25.0%
Interstitial	3	25.0%
Nodular	2	16.6%

Further Immunophenotyping was done in all 7 cases. The neoplastic lymphoid cells in all these cases were immunopositive for CD5, CD23, CD20 and negative for CD10, FMC-7, CD22, CD25, CD103, CD38, CD138, ZAP-70.

Non Hogkin's lymphoma (n=10)

All these patients lied in the age group of 60-80 years with male to female ratio of 1:1. These patients presented with symptoms of, weight loss, fever and hepatosplenomegaly. Bone marrow aspiration smears and bone marrow biopsy showed increase in lymphoid and lymphoplasmacytoid cells which were arranged in diffuse pattern in 2 cases, interstitial pattern in 1 case and nodular pattern in 1 case. In all these patients immunophenotyping was done which is described in table 28:

Table 28 : Immunophenotyping of Non Hodgkin's lymphoma

	Mantle cell lymphoma (n=1)	**Diffuse large B-cell lymphoma (n=3)**	**Lymphoplasmacytic lymphoma (n=3)**	**Marginal zone lymphoma (n=1)**	**Hairy cell leukemia (n=2)**
CD3	Negative	Negative	-	Negative	-
CD5	Negative	Negative	-	Negative	Negative
CD20	Positive	-	-	Positive	Positive
CD23	Negative	-	Negative	Negative	Negative
CD10	Negative	-	Negative	Negative	Negative
Bcl-2,	Positive	Positive	-	Positive	-
Cyclin D1	Positive	-	Negative	Negative	-
PAX5	-	-	Positive	-	-
CD138	Positive in few plasma cells	-	Positive in few plasma cells	-	Negative
CD38	-	-	-	-	Positive

CD103	-	-	-	-	Positive
CD25	-	-	-	-	Positive
LCA	-	Positive	-	Positive	-
MUM-1	-	Positive	Positive	Negative	-
Bcl-6	-	Positive	-	Negative	-
Tdt	-	Negative	-	Negative	-
CD30	-	Negative	-	-	-
CD-34	-	Negative	-	-	-
Alk-1	-	Negative	-	-	-
FMC-7	-	-	-	-	Negative
ZAP-70	-	-	-	-	Negative
CD22	-	-	-	-	Negative
MIB-1	-	90%	-	15%	-

While in one case of lymphoplasmacytic lymphoma IHC was not performed but on IFE - IgM lambda monoclonal gammopathy was seen and SPE showed M spike.

Out of these, 2 male patients(20%) presented with generalised weakness. On peripheral smear both patients were pancytopenic with presence of few lymphoid cells having cytoplasmic projections. Bone morrow aspirate was dry tap. Biopsy of both patients were hypercellular with presence of lymphoid cells having hyperchromatic oval to indented nuclei and clear cytoplasm giving fried egg appearance.

In one patient flowcytometry was done and neoplastic cells wereimmunopositive for were CD20 (Bright), CD25, CD103, CD38 and immunonegative for CD5, CD23, CD10,FMC-7, CD22, CD138, ZAP-70 while in other case no further investigation was done.

Also had one case of Classical Hodgkin's lymphoma who was 73 year old male . He presented with generalized weakness and on peripheral smear microcytic hypochromic anemia was seen. Aspirate of this patient was hypercellular with myeloid prominence and megakaryocytic hyperplasia and histiocytes were seen. On bone marrow biopsy similar findings were observed with presence of nodular collection of histiocytes and large cells. Further IHC was performed and large cells were immunopositive for CD-30, CD-20, and EBV - LMP1 came out to be immunopostive in large cells while immunonegative for LCA.

ACUTE LEUKEMIA

Acute leukemia was seen in 16 cases and most of the cases were in the age group of 60-70 years of age(63.6%) . Male preponderance was noted with male to female ratio of 2.2:1. These patients presented with weakness (93.8%) followed by loss of weight (6.3%).

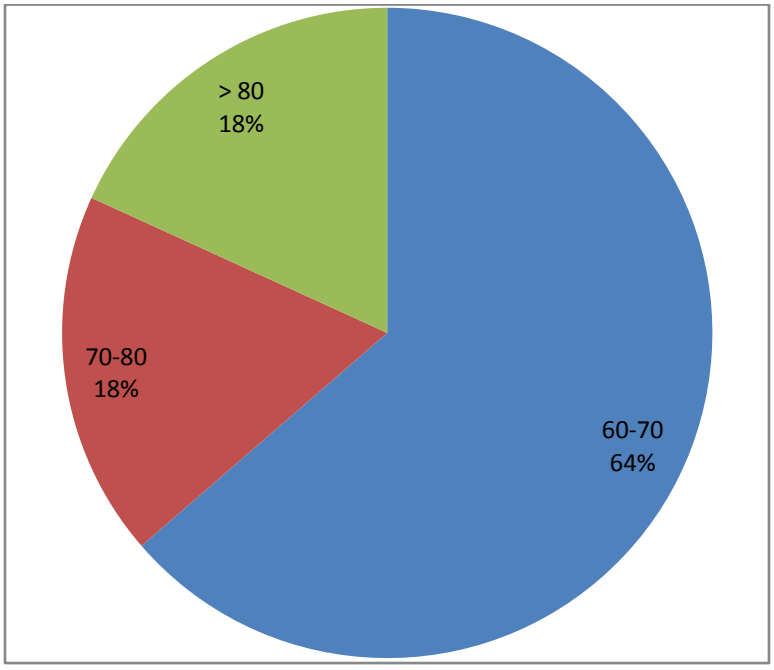


Figure 5: Age wise distribution of acute leukemia cases (n=16)

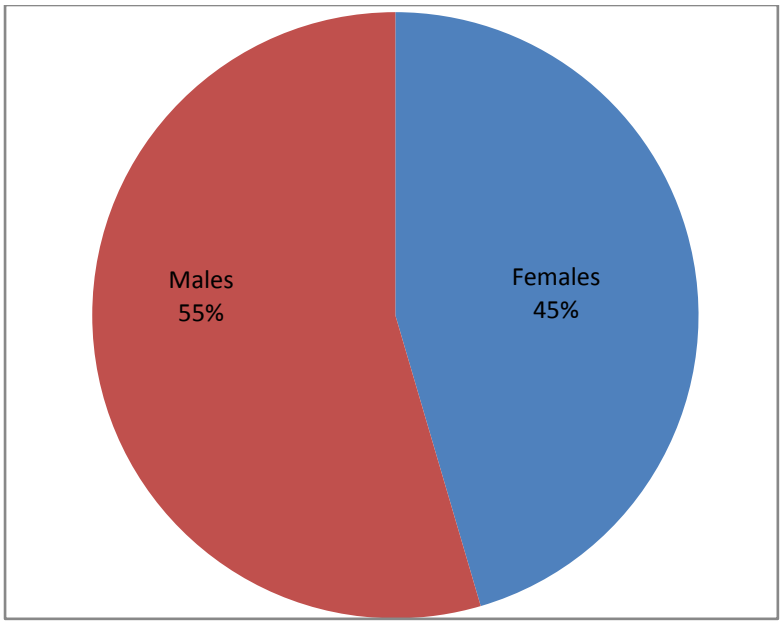


Figure 6: Gender wise distribution of acute leukemia cases(n=16)

Table 29: Clinical presentation in patients of acute leukemia (n=16)

	No. of cases	%age
Weakness	15	93.8%
Fever	7	43.8%
Abdominal pain	2	12.5%
Haemoptysis	1	6.3%
Loss of weight	1	6.3%

Table 30: Hematological parameters in patients of acute leukemia (n=16)

		No. of cases	%age
Hb g/dl	>12	0	0.00%
	8.1-11.9	4	25.00%
	5.1-8.0	10	62.50%
	≤ 5	2	12.50%
TLC x10^9/L	> 20	1	6.25%
	15.1-20.0	2	12.50%
	10.1-15.0	1	6.25%
	4-10.0	6	37.50%
	3.1-4	2	12.50%
	2.1-3	1	6.25%
	< 2	3	18.75%

PLT x10^3/ul	< 150x10^3	13	81.25%
	150-450	3	18.75%
	>450	0	0.00%

On peripheral blood film anemia was seen in all the cases. Normocytic normochromic anemia was commonly seen in these cases (15 cases,93.8%)which was followed by macrocytic RBC picture (9 cases,50.0%) and microcytic RBC picture (7 cases,31.3%). Blasts were seen in majority of the cases (93.8%) on peripheral smear.All cases of acute leukemia were further evaluated and were classified depending on various tests which were performed. These cases are described in table (31):

Table 31 : Distribution of cases of Acute leukemia (n=16)

	No. of cases	**%age**
Acute myeloid leukemia	8	50.0%
Acute lymphocytic leukemia	7	43.8%
Acute promyelocytic leukemia	1	6.3%
Total	16	100.0%

Acute myeloid leukemia (n=8)

There were eight cases which were diagnosed as AML with male to female ratio of 7:1 . 50% of these cases lied in the age group of 60 -70 years and 50% in 70-80 years of age group. These patients presented with generalized weakness (87.5%) followed by fever(25%) , shortness of breath (12.5%) and abdominal pain (12.5%). On physical examination of these patients, pallor was seen in 2 patients (25%), hepatomegaly was seen in 1 patient (12.5%) and hepatosplenomegaly in 1 patient (12.5%).

Table 32: Clinical presentation in patients of acute myeloid leukemia (n=8)

	No. of cases	%age
Weakness	7	87.5%
Fever	2	25.0%
Abdominal pain	1	12.5%
Shortness of breath	1	12.5%

Table 33 : General physical examination findings in patients of acute myeloid leukemia(n=8)

	No. of cases	%age
Pallor	2	25.0%
Hepatomegaly	1	12.5%
Hepatomegaly, Splenomegaly	1	12.5%
Splenomegaly	1	12.5%

Table 34: Hematological parameters in patients of acute myeloid leukemia(n=8)

		No. of cases	%age
Hb g/dl	>12	0	0.00%
	8.1-11.9	2	28.57%
	5.1-8.0	5	71.43%
	≤ 5	0	0.00%

TLC x10^9/L	> 20	1	14.29%
	15.1-20.0	2	28.57%
	10.1-15.0	0	0.00%
	4-10.0	2	28.57%
	3.1-4	2	28.57%
	2.1-3	0	0.00%
	< 2	1	14.29%
PLT x10^3/ul	< 150x10^3	8	114.29%
	150-450	0	0.00%
	>450	0	0.00%

On bone marrow aspirate smear and biopsy, marrow was hypercellular with infiltration blast in all of these cases.

Further flowcytometry was done in these patients and in 3 cases neoplastic cells were immunopositive for HLADR , CD34, CD117, CD13, CD33, CD64, CD38 and MPO and were immunonegative for CD11b, CD5, CD7,CD10, CD19, CD22, Cytoplasmic CD3, CD79a,Tdt, CD41, CD71, CD235a. In other 2 cases, the neoplastic cells were immunopositive for HLADR , CD34,CD117, CD13, CD33, CD64, CD38 and were immunonegative forMPO, CD11b, CD5, CD7, CD10, CD19, CD22, Cytoplasmic CD3, CD79a,Tdt, CD41, CD71, CD235a and was diagnosed as AML with monocytic differentiation .

While in the remaining 5 cases, on flowcytometery the neoplastic cells were immunopositive for HLADR , CD34, CD117, CD13, CD33 , CD38 , MPO and were immunonegative for CD64, CD11b, CD5, CD7, CD10,

CD19 , CD 125, CD22, Cytoplasmic CD3, CD79a,Tdt, CD41, CD71, CD235a and were diagnosed as acute myeloid leukemia.

Acute lymphoblastic leukemia (n=7)

There were 7 cases which were diagnosed as acute lymphoblastic leukemia with male to female ratio of 4:3 . All these cases were in the age group between 60 -70 years. Most common presentation of these patients was generalized weakness followed by fever . On physical examination, pallor was seen in 2 patients and hepatomegaly was seen in 1 patient and hepatosplenomegaly in 3 patients. On peripheral blood smear normocytic normochromic anemia was noted with presence of blasts ranging from 2%- 64% in all these cases. Infiltration of blasts was seen in all these cases of ALL and all cases were MPO negative on bone marrow aspiration smear and biopsy.

Further flow cytometry was done in 3 cases . In 3 cases markers the neoplastic cells were immunopositive for HLADR, CD34, CD10, CD19, CD38 , CD22, CD79a and immunonegative for MPO, CD117, CD13, CD33, CD14, CD64, CD11b, CD5, CD7, Cytoplasmic CD3, CD41, CD71, CD235a, CD25 and CD123 and was diagnosed as precursor B-lymphoblastic leukemia whereas in one case IHC was performed in which the neoplastic cells were immunopositive for Tdt,CD- 20,CD-34, and CD-10 were positive and negative for CD- 3 and CD-117 and was diagnosed as precursor B-lymphoblastic leukemia.

While in other 3 cases no further investigations were available. On immunohistochemistery, MPO was negative on bone marrow aspiration smear in these 3 cases.

One of the case included was 65 year old, female who presented with fever and generalized weakness. On peripheral smear, normocytic normochromic anemia with leucopenia and neutropenia was seen. Platelets were adequate in this case. On bone marrow aspirate smears

and biopsy, prominence of abnormal promyelocytes having cleaved nuclei and hypergranular cytoplasm were noted while other hematopoeitic elements were depressed. MPO was strongly positive in these abnormal promyelocytes. Further in this case PCR for Qualitative PML- RARA was performed and was positive for PML- RARA mutation which confirmed diagnosis of acute promyelocytic leukemia.

MYELODYSPLASTIC SYNDROME

In this study, there were total 12 cases which were diagnosed as myelodysplastic syndrome andhad male to female ratio of 1:1 . Majority of these cases were in the age group between 60 -70 years (66.6%) followed by >80 years(17%) and 70-80 years (16%). Most common presentation of these patients were generalized weakness (100%) followed by shortness of breath(16.6%).

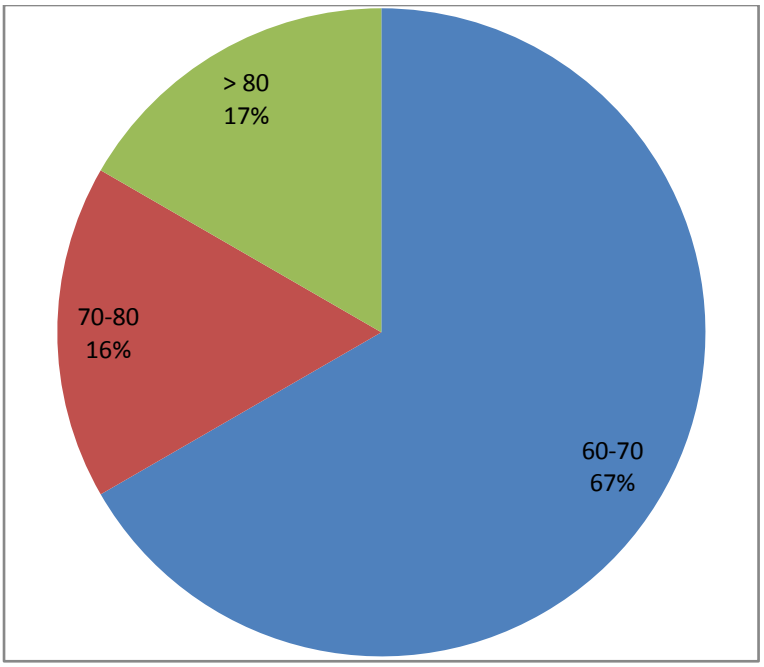


Figure 7: Age wise distribution of MDS cases(n=12)

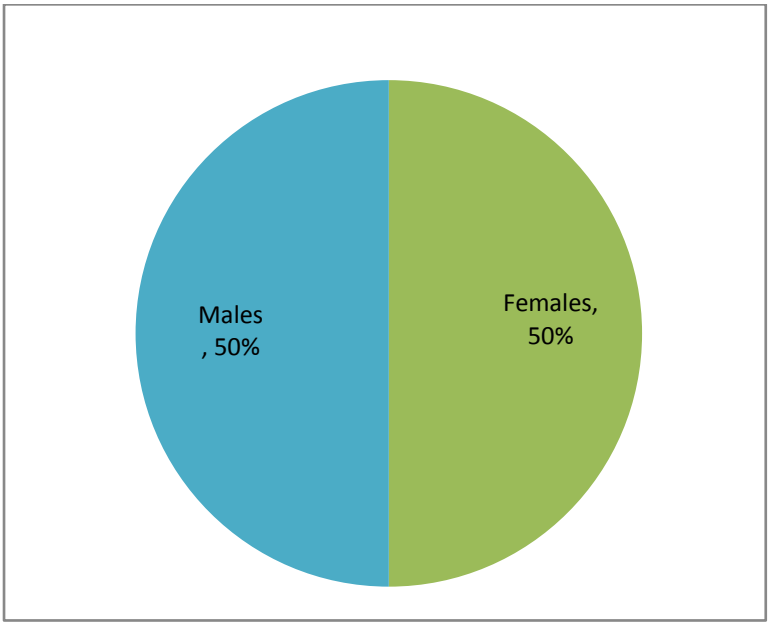


Figure 8: Gender wise distribution of MDS cases(n=12)

Table 35: Clinical presentation in patients of MDS (n=12)

	No. of cases	%age
Weakness	12	100.0%
Shortness of breath	2	16.6%

Table 36 : Hematological parameters in MDS cases (n=12)

		No. of cases	%age
Hb g/dl	>12	0	0.00%
	8.1-11.9	3	25.00%
	5.1-8.0	9	75.00%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	0	0.00%
	15.1-20.0	1	8.33%
	10.1-15.0	1	8.33%
	4-10.0	4	33.33%
	3.1-4	1	8.33%
	2.1-3	2	16.67%
	< 2	3	25.00%
PLT x10^3/ul	< 150x10^3	11	91.60%
	150-450	1	8.33%
	>450	0	0.00%

In all these cases the hematological picture was mild to moderate anemia and pancytopenia. On peripheral smear, these patients hadmacrocytosis , hypogranular neutrophils with pseudopuelger-Huet cells.Bone marrow aspirate smears of these patients were hypercellular exhibiting erythroid hyperplasia, megaloblastic maturation and features of dyserythropoiesis. Also seen was maturation arrest in myeloid series with presence of hypogranularity and hypersegmented forms. There were abnormal and young forms with hypogranular forms of megakaryocytes. In one of the case, maturation arrest was seen in myeloid series with blasts constituting more than 17% of all nucleated cells in the marrow .

Bone marrow biopsy also revealed features of dyserythropoiesis ,abnormal myelopoieses and dysmegakaryopoiesis in all of these cases. Reticulin stain highlighted increased fibrosis in one case (grade 1)

Table 37 : Bone marrow aspiration and biopsy findings in MDS cases (n=12)

Erythopoisis	Erythroid prominence with normoblastic maturation & with f/o dyserthropoiesis 10 %	5	41.6%
	Normoblastic and megaloblastic maturation with features of dyserythropoiesis > 10 %	4	33.3%
	Depressed with normoblastic maturation & f/o dyserythropoiesis > 10%	2	16.6%
Leucopoisis	Myeloid precursor show f/o dysmyelopoiesis > 10%	5	41.6%
	Orderly cell maturation	4	33.3%
	Depressed with features of dysmyelopoiesis	1	8.3%

Megakaryocytes	Present with dysplastic forms.	4	33.3%
	Hyperplasia with f/o dysmegakaryopoiesis in >10 %	3	8.3%
	Adequate	3	8.3%
	Reduced with atypical forms	2	16.6%

METASTATIC DEPOSITS

There were 3 cases in which metastatic deposits identified on bone marrow examination . All these cases were above 60 years old. One of the case presented with ptosis in left eye while other patient presented with weakness of leg and one presented with generalized weakness which was a known case of prostate carcinoma. Peripheral smear showed normocytic normochromic anemia with leucocytosis. Thrombocytopenia was seen in 2 cases while platelets were adequate in 1 case.

Table 38 : Bone marrow aspiration biopsy findings in cases of metastatic deposits (n=3)

No.	Age / Gender	Diagnosis
1	69 years/Male	Metastatic carcinomatous deposits to bone marrow. K/C/O- Carcinoma lung
2	77 years/ Male	Metastatic carcinomatous deposits to bone marrow and primary was from prostate (K/C/O Carcinoma prostate)

3	67 Years/Female	Metastatic carcinomatous deposits in bone marrow. Further IHC was performed on bone marrow biopsy which revealed primary lesion in breast as tumor cells were positive for CK,CK7,GATA3 and negative for CDX2,TTF-1,CK20 and P40.Further IHC was performed on Right iliac bone where ER , PR were positive in tumor cells and Her2/neu was negative in tumor cells.

CHRONIC MYELOMONOCYTIC LEUKEMIA

Ain this stusy, one case was CMML and who was a 74 year old male, presented with chief complaints of generalized weakness and leg pain. On peripheral smear he had microcytic hypochromic anemia and leucocytosis with absolute monocyte count 4.7x10^9/L. Platelets were adequate in number. Bone marrow aspirate smears were hypercellular exhibiting depressed erythroid series and having features of dyserythropoiesis upto 6% . Also myeloid hyperplasia with prominence of monocytes & monocytoid precursors which constitute 15% of all nucleated cells was noted. There was prominence of blasts which constituted 8% of all nucleated cells while megakaryocytes were adequate with M:E ratio being 6.4:1.

NON- NEOPLASTIC CASES

IDIOPATHIC THROMBOCYTOPENIC PURPURA (n=28)

There were 28 cases which were diagnosed as ITP. Most of these were in the age group of 60-70 year (64.2%) with male to female ratio of 1.2:1. These patients presented with pallor, petechial haemorrhages along with fever, generalized weakness and haemoptysis in one.

On peripheral smear normocytic, normochromic anemia with peripheral thrombocytopenia (range 10 - 70 x 10^9/ l) seen in all these cases . 12 cases(42.8%)had normal leucocyte count while leucocytosis was seen in 10 cases (35.7%) and leucopenia in 6 cases (21.4%).

Bone marrow aspirate smears had normocellular to hypercellular marrow. Erythroid series showed normoblastic maturation and myeloid precursors exhibited orderly cell maturation .Megakaryocytes were adequate in all of the cases with presence of young forms seen in 12 cases only.

Table 39 : Age wise distribution of ITP cases(n=28)

Age group	No. of cases	%age
60-70	18	64.2%
70-80	10	35.7%
> 80	0	0.0%

MEGALOBLASTIC ANEMIA (n=11)

In this study, the majority of megaloblastic anemia cases were in the age group of 60-70 years (63.6%) followed by 70- 80 years(18%) and >80 years (18%) with female preponderance (M:F – 1:1.7). Most common presentation in these patients were generalized weakness (72.7%) followed by loose stool (9.1%), abdominal pain (9.1%), fever (9.1%) and

loss of weight (9.1%). On physical examination of these patients, pallor was seen in 4 patients (36.4%) and spleenomegaly was seen in 4 patients (36.4%) and hepatomegaly in 1 patient (9.1%).

Table 40: Clinical presentation in patients of megaloblastic anemia cases(n=11)

	No. of cases	%age
Weakness	8	72.7%
Loose stool	1	9.1%
Abdominal pain	1	9.1%
Fever	1	9.1%
Loss of weight	1	9.1%

Table 41: General physical examination findings in patients of megaloblastic anemia cases(n=11)

General physical examination	No. of cases	%age
Pallor	4	36.4%
Splenomegaly	4	36.4%
Hepatomegaly	1	9.1%

Table 42: Hematological parameters in patients of megaloblastic anemia cases(n=11)

		No. of cases	%age
Hb g/dl	>12	0	0.00%
	8.1-11.9	6	54.55%
	5.1-8.0	3	27.27%
	≤ 5	2	18.18%
TLC x10^9/L	> 20	0	0.00%
	15.1-20.0	0	0.00%
	10.1-15.0	0	0.00%
	4-10.0	4	36.36%
	3.1-4	3	27.27%
	2.1-3	2	18.18%
	< 2	2	18.18%
PLT x10^3/ul	< 150x10^3	9	81.82%
	150-450	2	18.18%
	>450	0	0.00%

In all these cases macroovalocytes were noted on peripheral blood film. Also seen hypersegmented neutrophils in 7 cases(63.6%) . Bone marrow aspirate of all these cases were hypercellular which were exhibiting erythroid hyperplasia with megaloblastic maturation. Features of dyserythroposis (<10%) was seen in 7 cases. Myeloid series revealed giant metamyelocytes. Megakaryocytes were adequate in 8 cases (72.7%)

while megakaryocytic prominence was noted in 2 cases (18.18%) wheras1 case (9.1%) had megakaryocytic depression.

Table 43 : Bone marrow aspiration and biopsy findings in patients of megaloblastic anemia cases(n=11)

		Cases	%age
Cellularity	Hypercellular marrow	11	100%
Erythropoisis	Erythroid hyperplasia with normoblastic & megaloblastic maturation with features of dyserythropoiesis < 10 %	11	100%
Leucopoisis	Orderly cell maturation	7	63.6%
	Depressed with orderly cell maturation	4	33.3%
	Giant myelocytes	3	27.2%
Megakaryocytes	Adequate	8	72%
	Hyperplasia	3	27.2%

APLASTIC ANEMIA (n=8)

There were eight cases which were diagnosed as aplastic anemia . Majority of the cases were in the agegroup of 60-70 years (n=6, 75%) followed by 70-80 years (n=2, 25%) . Male preponderance was seen with

male to female ratio being 1.6:1 . These patients presented with generalized weakness (62.5%) followed by fever (37.5%),cough (25%) and bleeding (12.5%). No organomegaly was seen in any of the case.

Table 44: Hematological parameters in patients of aplastic anemia cases(n=8)

		No. of cases	**%age**
Hb g/dl	>12	0	0.00%
	8.1-11.9	4	50.00%
	5.1-8.0	4	50.00%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	0	0.00%
	15.1-20.0	0	0.00%
	10.1-15.0	0	0.00%
	4-10.0	2	25.00%
	3.1-4	0	0.00%
	2.1-3	0	0.00%
	< 2	6	75.00%
PLT x10^3/ul	< 150x10^3	7	87.50%
	150-450	1	12.50%
	>450	0	0.00%

All patients presented with anemia. Leucopenia with neutropenia was seen in 75% cases(6 cases) and thrombocytopenia was present in (7 cases) 87.5% cases. On peripheral blood smear, normocytic normochromic RBC picture was seen in 4 cases and macrocytic RBC picture was seen in 2 cases.

Bone marrow examination showed hypocellular marrow in 5 cases whereas 2 cases were diluted with blood and dry tap was obtained in one case . There was relative prominence of plasma cells and lymphocytes and all other normal hematopoeitic elements were depressed in all the cases and no atypical features were seen in any lineage.

Table 45 : Bone marrow aspiration and biopsy findings in aplastic anemia patients (n=8)

		Cases	%age
Cellularity	Hypocellular marrow with increased fat space	8	100%
Erythropoisis	Depressed with normoblastic maturation	8	100%
Myelopoisis	Depressed	8	100%
Megakaryocytes	Depressed	6	75%

ANEMIA OF CHRONIC DISORDER (n=9)

There were 9 cases diagnosed as anemia of chronic disorder with male to female ratio of 2.5:1. Most were in the age group between 60 -70 years (66.6%) followed by 70-80 years (22%) and >80 years (11%). Most common presentation in these patients were generalized weakness (71.4%). On physical examination of these cases, pallor was seen in 4

patients (57.1%) , hepatomegaly in 1 patient (14.3%) and spleenomegaly in 2 patients (28.6%).

Table 46 : Clinical presentation in patients of anemia of chronic disorder (n=9)

Signs & symptoms	No. of cases	%age
Pallor	4	57.1%
Hepatomegaly	1	14.3%
Splenomegaly	2	28.6%

Hypercellular marrow was seen in 4 of these cases (57.2%) on bone marrow aspirate and biopsy while others had normocellular marrow (71.4%). In most of the cases (77.7%) erythroid series showed normal maturation while erythroid prominence was seen in 2 cases (28.5%). Megakaryocytes were prominent in 3 cases (42.8%) while others had adequate megakaryocytes. Myeloid series exhibit orderly cell maturation. In all these cases, iron on Perl's stain was increased and were graded from 5+ to 6+.

Table 47: Hematological parameters in anemia of chronic disorder patients (n=9)

		No. of cases	%age
Hb g/dl	>12	0	0.00%
	8.1-11.9	5	55.55%
	5.1-8.0	4	57.14%
	≤ 5	0	0.00%
TLC x10^9/L	> 20	0	0.00%
	15.1-20.0	0	0.00%
	10.1-15.0	1	14.29%
	4-10.0	8	88.88%
	3.1-4	0	0.00%
	2.1-3	0	0.00%
	< 2	0	0.00%
PLT x10^3/ul	< 150x10^3	2	28.57%
	150-450	7	77.77%
	>450	0	0.00%

Table 48 : Bone marrow aspiration and biopsy findings in anemia of chronic disorder patients (n=7)

		Cases	%age
Cellularity	Hypercellular marrow	4	57.2%
	Normocellular marrow	5	71.4%
Erythropoisis	Normoblastic maturation	7	77.7%
	Prominence with normoblastic & megaloblastic maturation.	2	28.5%
Leucopoisis	Orderly cell maturation	9	100%
Megakaryocytes	Adequate	6	66.6%
	Prominent	3	42.8%

HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS (n=6)

There were 6 male patients who were diagnosed as HLH. Majority were in the age group of 60 -70 years(67%) followed by 70-80 years(33%).These patients presented with generalized weakness (83.3%) followed by fever(16.7%), shortness of breath(16.7%),leg pain (16.7%) and abdominal pain(16.7%).

Among these 6 cases, 4 presented with pancytopenia while 2 cases presented with bicytopenia. On peripheral smear normocytic normochromic anemia was seen in 2 cases (33.3%), microcytic hypochromic anemia was observed in 2 cases (33.3%) and macrocytic anemia in 2 cases (33.3%). Leucopenia with neutropenia was seen in 5 cases (83.3%) while leucocytosis was seen in 1 case (16.7%). Thrombocytopenia was noted in 4 cases.

Bone marrow aspirate smears of these patients were hypocellular to hypercellular. Erythroid prominence was seen in 2 cases (33.3%) while erythroid depression in 1 case (16.7%) and in the remaining cases normoblastic maturation was noted. Maturation arrest of myeloid precursors at myelocyte stage was noted in 2 cases (33.3%) while in the remaining cases an orderly cell maturation noted. Megakaryocytes were adequate in 4 cases (66.7%) whereas in 2 cases (33.3%) megakaryocytic depression was observed. In all these cases histiocytes were noted which were phagocytosing erythroid precursors , myeloid precursors(hemophagocytosis).

LEUKEMOID REACTION (n=5)

There were five cases with male to female ratio-3:2 who presented with fever and one with burning micturition. On peripheral blood smear leucocytosis with neutrophila was seen. Bone marrow aspirate smear of these patients were hypercellular exhibiting myeloid prominence with an orderly cell maturation . Megakaryocytes were prominent in 3 cases while in remaining cases megakaryocytes were adequate. LAP score was performed in all the cases and it was high in all cases(mean 300). In view of peripheral smear , bonemarrow findings and lap score diagnosis of leukemoid reaction was given.

HEMOLYTIC ANAEMIA (n=4)

There were four cases which were diagnosed as hemolytic anaemia . These patients presented with generalized weakness and one patient complains of melena. Hepatomegaly was seen in 1 case and spleenomegaly in 2 cases.

In all thesecases mild to severe anemia was noted with hemoglobin ranged from 5.6-8.9 g/dL. Leucocyte count was within normal limits except in one case which had mild leucocytosis. Thrombocytopenia was seen in 3 cases while the remaining case had normal platelet count. On peripheral

smear moderate anispoikilocytosis noted with presence of macrocytosis, polychromasia along with schistocytes. Corrected reticulocyte count was increased in 3 case while in the remaining case it was within normal range.

Aspirate of these patients were hypercellular which were showing erythroid hyperplasia with normoblastic & megaloblastic maturation. Myeloid precursors showed orderly cell maturation and megakaryocytes were adequate in these patients. Perl's stain for iron was adequate in all cases except in one which had reduced iron stores. Biopsy section and imprint smears gave no additional information. Further investigations revealed ANA positivity and indirect coombs test, which was positive in one case and final diagnosis was made as autoimmune hemolytic anemia.

HYPEREOSINOPHILIC SYNDROME

A 73 year old, male and 60 year, old female presented with fever and generalized weakness. On peripheral smear, normocytic normochromic anemia with marked eosinophillia (45% and 70% eosinophils respectively) was seen in these patients. Aspirates of these patients were hypercellular which were showing marked increase in eosinophilic precursors (45% and 60% respectively). However, no prominence of blasts seen on bone marrow aspiration and biopsy.

IRON DEFICIENCY ANEMIA

A 69 year old male, presented with chief complaints of generalized weakness and loss of appetite. His serum iron was low (50mcg/dl). On peripheral smear microcytic hypochromic picture was seen. Bone marrow aspiration and biopsy revealed normocellular marrow which was exhibiting erythroid prominence and normoblastic maturation. Also seen micronormoblasts. Myeloid precursors exhibit orderly cell maturation and megakaryocytes were adequate in this patient. Perl's stain for iron showed

absent iron stores in the aspiration smears. In view of of peripheral smear and bone marrow findings, iron deficiency anemia was made.

GRANULOMATOUS INFLAMMATION

A 62 year old male, presented with weakness, loss of appetite, backache and loss of weight. On PBF, leucocytosis with neutrophilia was seen. Bone marrow aspirates showed hypercellular marrow with myeloid series showing orderly cell maturation. Erythropoeisis showed normoblastic maturation along with adequate megakaryocytes. On bone marrow biopsy granulomas was seen . All the normal hematopoetic elements in this case exhibit normal morphology and maturation. 20% of ZN stain for AFB was negative.

LEISHMANIASIS

A 67 year old male, presented with fever and generalized weakness. On peripheral smear pancytopenia was noted. Bone marrow aspirates showed hypercellular marrow with erythroid precursors exhibiting normoblastic as well as megaloblastic maturation with features of dyserythropoiesis which was seen in less than 10% of all nucleated cells. Myeloid hyperplasia was noted along with hyperplasia of megakaryocytes .Also seen histiocytes which showed presence of amastigote forms of leishmenia donovani intracellular and extracellular.

RED CELL APLASIA

A 67 year old female who was known case of thymoma, presented with anemia. On peripheral smear, normocytic normochromic anemia was seen. Bone marrow aspirate and biopsy showed hypercellular marrow with myeloid series showing orderly cell maturation, erythropoisis was markedly suppressed and megakaryocytes were adequate in this case.

NORMOCELLULAR NORMOBLASTIC MARROW (n=11)

There were 11 cases of normocellular normoblastic marrow with male to female ratio of 1.75:1. Most of the cases were in the age group of 60 -70 years(72.1%). These patients presented with generalized weakness (72.1%) followed by fever(9.0%), burning micturation (9.0%) and bachache (9.0%) .

Table 49: Age wise distribution of Normocellular normoblastic marrow cases (n=11)

Age group	No. of cases	%age
60-70	8	72.1%
70-80	2	18.1%
> 80	1	9.0%

Table 50 : Gender wise distribution of Normocellular normoblastic marrow cases(n=11)

Gender	No. of cases	%age
Female	7	63.6%
Male	4	36.3%

Table 51: Signs and symptoms in patients of normocellular normoblastic marrow (n=11)

	No. of cases	%age
Weakness	8	72.7%
Fever	1	9.0%
Burning micturition	1	9.0%
Backache	1	9.0%

On peripheral smear, anemia was noted in majority of the cases (63.63%). TLC was within normal limits in 54.54 % of cases while leucocytosis was seen in 45.36% of cases. Bone marrow aspirates of these patients were normocellular marrow with myeloid series showing orderly cell maturation, erythropoisis was normoblastic maturation and megakaryocytes were adequate.

Table 52: Hematological parameters in patients with normocellular normoblastic marrow (n=11)

		No. of cases	%age
Hb g/dl	>12	4	36.36%
	8.1-11.9	4	36.36 %
	5.1-8.0	3	27.27%
	≤ 5	0	00%
TLC x10^9/L	> 20	2	18.18%
	15.1-20.0	1	9.0%
	10.1-15.0	2	18.18%
	4-10.0	6	54.54%
	3.1-4	0	00.00%
	2.1-3	0	00.00%
	< 2	0	00.00%
PLT x10^3/ul	< 150	0	00.00%
	150-450	10	90.9%
	>450	1	9.0%

Table 53: Bone marrow aspiration and biopsy findings

		Cases	%age
Cellularity	Normocellular marrow	11	100%
Erythropoiesis	Normoblastic maturation	11	86.6%
Leucopoiesis	Orderly cell maturation	11	100%
Megakaryocytes	Adequate	11	100%

So in the present study a vast range of diagnosis were encountered in geriatric patients undergoing bone marrow examination.

DISCUSSION

The present one year prospective study was conducted on geriatric patients from March 2021 to March, 2022 in Pathology Department, DMCH, Ludhiana. This study included a total of 206 cases and were analyzed with respect to clinical findings, hematological parameters and bone marrow features. Of 206 cases included majority [n=130, 63%] were in the age group of 60 to 70 years of age group with age range of 60 to 92 years with mean age being 68.4 years. Male preponderance was noted with Male:Female ratio of 1.6:1. This was found be in concordance with studies conducted by Chandra, et.al [102] and Anchana Gulatiet.al [5] and M S Sulakshana et.al [103], Manion EM, et al.[104] and Teke HU et al[105]

Table 54 : Comparison of age and sex with other studies

Authors	**Age range**	**Mean age**	**M:F**
Chandra, et al.[102]	60 to 84 years	66.2 years	1.7:1
Manion EM, et al.[104]	85 to 99 years.	-	1.2:1
Gulati A et al.[5]	60-79 years	61 years	1.3:1
M S Sulakshana et al.[103]	60 to 82 years	-	1.1:1
Teke HU et al[105]	85-93 years	86.3 years	1.8:1
Present study	60-92 years	68.4 years	1.6:1

In this study, suspicion of plasma cell dyscrasia/ multiple myeloma were the most common indication, accounting for 23% of the cases.. This observation varies from other studies. Study by Manion EM et al[104], M S

Sulakshana et al[103] and Teke HU et al[105], cytopenias were considered to be the most common indication for bone marrow examination in the geriatric population. In another study of Chandra H et al[102] suspicion of lymphoma was most common indication.

Table 55: Comparison of clinical indications with other studies

	Chandra H et al[102]	Manion EM, et al[104]	M S Sulakshana et al[103]	Teke HU et al[105]	Present study
Suspicion of lymphoma	18.5%	5%	14%	0.9%	00%
Cytopenias(pancytopenia)	17.3%	36.1%	54%	%	17%
Plasma cell dyscrasia/ multiple myeloma	16.6%	10.9%	20%	0.9%	23%
Leucocytosis	00%	14.3%	4%	16.7 %	6%
ITP/Thrombocytopenia	1.9%	2.5%	2%	6.14 %	14%

In our study, pancytopenia was the second most common indication (n=36, 17%) for bone marrow examination in elderly patients similar to study by Chandra, et al.[102] where cytopenia was the second most common clinical indication for bone marrow examination in elderly patients.

In this study hemoglobin levels in elderly varied from 4.0 to 18.1 g/dl , white blood cell varied from 0.3x10^9/L to 439x10^9/L and platelet count

varied from 4 x10^3/ul to 2627x10^3/ul while in study by M S Sulakshana et al[103] where hemoglobin levels ranged from 3.0 to 10.6 g/dl , white blood cell varied from 1.2x10^9/L to 170x10^9/L and platelet count varied from 20 x10^3/ul to 160x10^3/ul.

Table 56: Comparison of haematological parameters with other studies

	Manion EM, et al[104]	**M S Sulakshana et al[103]**	**Teke HU et al [105]**	**Present study**
Hemoglobin (gm/dl)	6.7-11.6	3-10.6	3.3-16.5	4-18.1
TLC (x10^9/L)	1.5-4.5	1.2-170	0.2-243	0.3-439
Platelets (10^3/ul	29-120	20-60	3-220	4-2627

In our study, all cases were divided into neoplastic and non neoplastic cases. Out of the 206 cases, majority of the cases (56.3%) were neoplastic cases while non-neoplastic cases were 43.6% Similiary in studies conducted by Manion EM, et al[104], Teke HU et al [105] and Gulati A et al.[5] most of the cases were neoplastic than nonneoplastic.

Table 57: Comparison of neoplastic and non-neoplastic cases with other studies

	Manion EM, et al[104]	**Teke HU et al [105]**	**Gulati A et al.[5]**	**Present study**
Neoplastic cases	43%	85.9%	43.3%	56.3%
Non neoplastic cases	57%	14.1%	56.7%	43.7%

In our study, among neoplastic cases, majority were diagnosed with plasma cell neoplasm (18.9%) followed by myeloproliferative neoplasm (12.10%). Among plasma cell neoplasms, multiple myeloma (16.5%) was the commonest diagnosis made on bone marrow examination in elderly patients which is in concordance with the study conducted by M S Sulakshana et al [103] who also found plasma cell dyscrasia (multiple myeloma and MGUS) to be the commonest in elderly while in study conducted by Gulati A et al[5] multiple myeloma was most common finding among neoplastic conditions. Whereas Manion EM et al.[104] in their study observed myelodysplastic syndrome as the most common specific diagnosis in patients above 85 years of age on bone marrow biopsy. In a study conducted by Teke HU et al [105], they observed MDS to be the commonest diagnosis in their study (19.3%) (table-58)

Table 58 : Comparison of final neoplastic diagnosis on bone marrow examination with other studies

Neoplastic cases	Chandra H et al[102] n=156 (%age)	Manion EM, et al[104] n=119 (%age)	M S Sulaksha na et al[103] n=50 (%age)	Gulati A et al[5] n=97 (%age)	Teke HU et al[105] (%age)	Present study n=206 (%age)
Multiple myeloma	10.8	4.2	12	18	10.5	16.5
MGUS	-	-	4	-	0.9	0.9
Chronic myeloid leukemia	11.5	8.4	-	-	0.9	5.3
Essential thrombocythemia	0.6	-	-	-	0.9	2.9
Melofibrosis	1.9	-	4	3.6	0.9	2.4
Chronic lymphocytic leukemia	0.6	4.2	6		3.5	5.8

Non Hodgkin's lymphoma	10.8	**-**	**-**	14.8	6.3	3.8
Hairy cell leukemia	**-**	**-**	**-**	**-**	0.9	0.9
Hodgkin's lymphoma	**-**	**-**	**-**	**-**	**-**	0.4
Acute lymphoblastic leukemia	3.8	**-**	**-**	4.8	0.9	3.3
Acute myeloid leukemia	**-**	2.5	4	**-**	14.9	3.8
Myelodysplastic syndrome	1.2	9.2	2	**-**	27.2	5.80
Metastasis	3.8	**-**	4	3.6	**-**	1.40
Chronic myelomonocytic leukemia	0.6	**-**	**-**	**-**	2.6	0.4

In our study, among non neoplastic cases, Idiopathic thrombocytopenic purpura (13.5%) was commonly seen while there were only 7.2% cases in whom normocellular normoblastic marrow was observed. This study is different from Chandra H et al [102] study where maximum number of cases turned out to be normocellular on bone marrow examination. Comparison of final non neoplastic cases with other studies are described in table-59.

Table 59 : Comparison of final non-neoplastic diagnosis on bone marrow examination with other studies

Non-neoplastic cases	Chandra H et al[102] n=156 (%age)	Manion EM, et al[104] n=119 (%age)	M S Sulaksha na et al[103] n=50 (%age)	Gulati A et al[5] n=97 (%age)	Teke HU et al[105] (%age)	Present study n=206 (%age)
Idiopathic thrombocytopenic purpura	1.9	-	-	-	7	13.10
Megaloblastic anemia	3.2	-	-	6	-	5.30
Aplastic anemia	3.2	-	6	3.6	-	3.80
Anemia of chronic disorder	-	-	-	-	-	4.30
Hemophagocytic lymphohistiocyto	-	-	-	-	-	2.90

sis						
Leukomoid reaction	**-**	**-**	**-**	**-**	**-**	2.40
Hemolytic anemia	**-**	**-**	**-**	**-**	**-**	1.80
Dual deficiency anemia	1.9	-	54	18	-	0.90
Iron deficiency anemia	11.5	**-**	**-**	**-**	**-**	0.40
Leishmaniasis	0.6	**-**	**-**	1.2	-	0.40
Granulomatous inflammation	**-**	**-**	**-**	**-**	**-**	0.40
Red cell aplasia	**-**	**-**	**-**	**-**	**-**	0.40
Normocellular normoblastic marrow	**-**	**-**	**-**	16.8	14	5.3
Bone marrow necrosis	**-**	**-**	**-**	1.2	-	-
Hypereosinophilic syndrome	2.5	**-**	**-**	1.2	0.9	0.97

NEOPLASTIC CASES

MULTIPLE MYELOMA

Majority of these patients were in the age group of 60 -70 years(76.5%) with M:F=1.1:1.Various studies regarding age and sex distribution are compared in (table 60)

Table 60: Comparision of age and sex distribution

Authors	Mean age (years)	M:F ratio
Kyle RA et al[108]	66	1.4:1
Choudhary S al [109]	63.25	2.5:1
Hussain A et al [110]	61	1:1.3
Diwan AG et al [111] .	62	1:1
Kaur P et al [112]	58.8	1.5:1
Present study	68.4	1.1:1

Clinical history was taken and the presenting symptoms were recorded. Generalized weakness was the most common presenting complaint observed in 61.8 % of our patients which is mainly attributable to anemia. These observations were intermediate to studies conducted by Diwan AG et al[111], Kaur P et al[112], Kalita LK al et [113] and. Kyle RA et al [108] with 55% , 46.4%, 41% and 32% respectively presenting with similar complaints. Bone pain was seen in 47.1% patients which may be due vertebral collapse, osteopenia or fractures. The observations in present study are in concordance with Kalita LK et al[113] with 44% patients having bone pains at the time of diagnosis. Studies conducted by Diwan AG et al[111], Kaur P et al[112] , Kaushik R et al [114] and Shaheen H et al[115]

highlighted bone pains in 85%, 82%, 50%, 50% patients respectively. Hepatosplenomegaly was observed in 14.1% cases our study which was lower than study of Kaur P et al[112] (39.3%.) but higher as compare to Kalita LK et al[113] (5%) and Kaushik R et al[114](10%). However, others did not encounter any oranomegaly in their subjects. The clinical finding multiple myeloma in various studies are depicted in Table 61–

Table 61 : Comparison of clinical findings in multiple myeloma

Clinical findings	**Shaheen H et al[115] (%age)**	**Kyle RA et al[108] (%age)**	**Kalita LK et al[113] (%age)**	**Diwan AG et al[111] (%age)**	**Kaushik R et al [114] (%age)**	**Kaur P et al[112] (%age)**	**Present study (%age)**
Generalized weakness	78	32	41	55	13	46.4	61.8
Bone pain	82	58	44	85	50	50	47.1
Fever	36	0.7	06	35	13	00	14.7
Renal failure	43	55	06	30	24	12.1	5.9
Bleeding manifestations	11	00	00	10	08	00	5.9
Organomegaly	00	00	05	00	10	39.3	14.7

Anaemia in myeloma is caused due to replacement of marrow by myeloma cells and decreased production of erythropoietin due to accompanying real involvement. In some cases it may be associated withcytokine mediated bone marrow suppression .Hemoglobin values in our patients ranged from 4.7 to 13.3 g/dl. The anemia was normocytic normochromic in majority of our patients as reported in literature. (Kyle RA et al[108], Kaur P et al[112]). Leucocytosis (Total leucocyte count >10x10^9/L) was noted in 23.5% of our patients which is lower in study by Hussain A et al [110] (9.1%), Kyle RA et al [108](8%) while in study by Kyle RA et al [108] reported Lencopenia at presentation in 20% patients which was quite higher as compared to our study where no case of leucopenia observed.

Lytic lesions were coomon findings on radiological examimination and were observed in 35.2% of our patients of multiple myeloma.these lesions were seen as multiple punched out lesions on skull followed by vertebrae. These observations are in concordance with various studies by Kalita LK et al [113] (42%.) and Kaushik R et al[114] (51%).

Thrombocytopenia (platelet count <150X10%) was seen in 20.5% of our patients with multiple myeloma. Studies conducted by Kyle RA et al[108] and Hussain A et al[110] and Diwan AG et al [111]elicited thrombocytopenia in 5% ,14.2% and 10% respectively. Thrombocytopenia is uncommon in early phases of myeloma, possibly because of thrombopoetic activity of IL-6, but can be seen later on due to infilteration of the marrow by plasma cell, infection or cardiovascular destruction of platelets. M Band was detectable in 25 cases (73.5%) on serum protein electrophoresis. In various studies. Kyle RA et al[108] , Diwan AG et al[111], Hussan A et al [110] M band was observed in 82% & 100% and 70.8%. patients respectively. In rest 9(26.4%) of our patients serum protein electrophoresis was not available and diagnosis was made on the basis of plasma cells on bone marrow aspiration which was >60%. Calcium levels were raised in 14

patients (41.1%) with a mean 14.2mg/dl. In studies conducted by Hussan A et al[110], Kyle et al [108] observed hypercalcemia in 30% and 11.76% patents respectively.

Serum creatinine levels were raised in 10 patients (29.4%) which wassimial to Kyle RA et al [108](19%) and Diwan AG et al[111] (30%).

In this study plasma cells in bone marrow aspirate at the time of presentation was >60% in 47% cases which was similar to studies by Kyle RA et al [108](34%) and Diwan AG et al[111] (55%).

In our study majority of cases had interstitial involvement (38.5%) followed by mixed pattern-10 cases(25.6%) , diffuse pattern- 8 cases (20.5%) and nodular pattern-1case (2.6%). However , in the study by Kaushik R et al[114], diffuse involvment was seen in 64% cases and interstial involevement in 18% cases . Study by Subramanian R et al[116] observed 64% cases having diffuse involvement and 27% cases showed interstitial involvement.

CHRONIC MYELOID LEUKEMIA

Of the 24 cases of myeloproliferative neoplasms, majority [n=11, 45.8 %] were classified as chronic myeloid leukemia according to WHO criteria [2016]. After correlating the hematological parameters and bone marrow findings, all these 11 cases [100%] were categorized into chronic phase while. In a study by Bansal S et al. [117], 97 % of cases were in the chronic phase of CML, whereas the remaining 3 % were in the accelerated phase.

Bhatti FA et al[118], also observed CML being the predominant [335/425] MPN and majority being in chronic phase 240 cases [71.6 %] but accelerated phase [n= 49,14.6 %] and blast phase [n= 31 cases,9.3 %] category patients were significantly higher as compared to our observation. This could be attributed to larger sample size in their study.

Age and sex distribution

We observed that majority of CML patients [6 cases, 54.5 %] were in the age group 60-70 years, followed by 70-80 years [4 cases, 36.3 %], with a mean age of 64.7 years, and M:F ratio of 2.6:1. Similarily Bower H et al[119] observed the most common age group affected was between 60-69 years old, with a mean age of 69 years, with M:F ratio of 1.1:1

Kumar S et al.[120], observed the most common age group affected was between 31 and 40 years old, with a mean age of 38.6 years, with M:F ratio of 1.4:1 [57.8 % males and 42.2 % females]. Singhal MK et al.[121], reported the mean age of presentation in CML patients was 55 years, with a slight male predominance and a M:F ratio of 1:0.8. Similarly, in a study conducted by Inam Al-abady I et. al[122], the average age of presentation was 41.9 years, with a M:F ratio of 1.3:1. These studies observed CML in lower age group but preponderance of male group was similar with our findings.

Table 62: Comparison of age and sex distribution with other studies

Authors	**Mean age [years]**	**M:F**
Bower H et al[119]	69	1.1:1
Kumar S et.al[120]	38.6	1.4:1
Al-abady I et. al[122]	41.9	1.3:1
Singhal MK et.al[121]	55	1:0.8
Present study	64.7	2.6:1

Clinical presentations and organomegaly

The majority of patients in our study had generalized weakness [9, 80 %], followed by fever [2, 18 %], weight loss [1, 8 %]. These findings are consistent with those of Kumar S et al.[120], they observed that the most prevalent complaints of patients were generalised weakness [63 %], fever [59 %], and fatigue [55.5 %]. They reported that 99 % of the patients had splenomegaly, while in our study we observed splenomegaly in 3/11 cases [27.2 %] similiar to Cotta CV et al[123] , they reported that 50% of CML patients showed splenomegaly. According to a studies conducted by Ganesan P et al [124], Bansal S et al [117], and Hoffmann VS et al.[125], all reported that a higher proportion of patients have organomegaly. Okano M et al.[126] reported splenomegaly in up to 100% of patients.

A study conducted by Castagnetti F et al[127] found in CML cases spenomegaly is less commonly reported as patient's age increases. He observed 71% cases had splenomegaly in age group 18-29 year , 63% in age group 30-59 year old and 55% in elderly patients with age more than 60 year old. These findings are consistent with our findings. Frequencyof splenomegaly in CML patients in different studies done by Kumar S et.al[120],Ganesan P et.al[124],Bansal S et.al[117], Singhal MK et.al[121],Hoffmann VS et.al[125],Cotta CV et.al[123],Castagnetti F et al[127]and present study are83.33%, 95%, 80%, 100%, 46.5%, 50%, 55%, 27.2%

Hematological parameters

We observed that majority of CML patients [5, 45.45 %] presented with moderate anemia [Hb 8.1-10.9 gm/dl]. 2 patients [18.18 %] had severe anemia, and 1 [9.0 %] had mild anemia. Similar observations were made by Kumar et al. [120] with 45 [64.21 %] of the cases having moderate anemia while mild anemia, and severe anemia being noted in 30% and 5.7% respectively. Further, Singhal MK et al [121], Mottalib MA et al[128] also reported concordant findings [Table 63] However, Jonte F et al.

[129]observed most patients with mild anemia [47.4 %], while moderate anemia [36%], and severe anemia [16.6 %] were less frequent.

Table 63: Distribution of hemoglobin in CML cases

Authors	**% of patients with moderate anemia**	**% of patients with mild anemia**	**% of patients with severe anemia**
Kumar S et.al [120]	64.21%	30%	5.71%
Singhal MK et.al [121]	78%	14%	10%
Mottalib MA et.al [128]	58.33%	33.33%	10.41%
Present study	45.45%	9.0%	18.18%

In our study majority [90.9 %] of patients had varying degrees of leucocytosis at presentation, with 2[18.18%] cases having hyperleucocytosis [>100.1X103/ul], 3 cases [27 %] having moderate leucocytosis [TLC ranging 50-100x103/uL], and 5 cases [45 %] having mild leucocytosis [TLC ranging 11.1/49.9x103/uL]. This is disconcordant with the findings of Kumar S et al. [120]. They concluded that the majority of cases [77.8 %] had hyperleukocytosis, 20.2 % had moderate leukocytosis, and 2% had mild leukocytosis. Similarly conclusions were reached in studies conducted by Mottalib MA et al [128], Bansal S et al [117], Singhal MK et al [121], and Hoffmann VS et al.[125][Table 64]

Table 64 : Distribution of hyperleucocytosis in CML cases

Authors	**TLC <50x10^3/ul**	**TLC 50-100x10^3/ul**	**TLC >100x10^3/ul**
Kumar S et.al [120]	2%	20.2%	77.8%
Bansal S et.al [117]	6.5%	26.5%	67%
Singhal MK et.al [121]	7.7%	30%	62.3%
Mottalib MA et.al [128]	6.25%	33.33%	72%
Hoffmann VS et.al [125]	12%	20.7%	67.3%
Present study	45%	27%	18.18%

A significant left shift in granulocytes was seen in 10 patients [99.9 %] when differential leucocyte counts were examined. Basophilia [range from 1 to 2 %] was observed in 5 cases [45.0 %]. While in a study conducted by Kumar S et al. [120], basophilia was found in 98.8 % of cases. Similar observations were made by Jonte F et al [129] and Hoffmann VS et al.[125] [Table 65]

Table 65: Differential leucocyte count in CML cases

Authors	% of cases with basophilia
Kumar et.al [120]	98.8%
Hoffmann et.al [125]	90%
Jonte et.al [129]	83%
Present study	45%

All the patients in our study, 100% had blast count < 10% , similarly Jonte F et al [129] observed that none of the patients were in a blast crisis. While, Kumar S et al. [120] reported that 5% of cases, Hoffmann VS et al. [125] reported that 2.2 % of cases, and Mottalib MA et al. [128] reported that 3% of cases were in a blast crisis. This could be attributed to larger sample size in their study.

In the present study, the majority of patients [8 cases, 72.7 %] had platelet counts in the normal range, ranging from 150x103/ul to 450x10^3/uL. One patient had thrombocytopenia with platelet counts of 40x103/ul, while 22 patients [18.18%] had thrombocytosis with platelet counts ranging from 450 to 1000x10^3/uL. Similarly Savage DG et al.[130] also reported that the majority of patients [47 %, 155 cases out of 430] had normal platelet counts, 36.2 % had thrombocytosis, and just 4.5 % had thrombocytopenia.

Similar observations were made in studies conducted by Mottalib MA et al. [128], Kumar S et al. [120]. [Table 66]

These findings were contradicted by Jonte F et al. [129] they reported that the majority of patients [48%] had thrombocytosis, 41% had normal platelet counts, and 11 % had thrombocytopenia. [Table 66]

Table 66: Distribution of platelet counts in CML cases

Authors	**Normal range platelet count [150-450x10^3/ul**	**Thrombocytopenia <150x10^3/ul**	**Thrombocytosis >450x10^3/ul**
Kumar S et.al[120]	68.9%	6.7%	24.4%
Mottalib MA et.al [128]	81.2%	8.4%	10.4%
Savage DG et.al[130]	7%	4.5%	36.2
Jonte F et.al[129]	41%	11%	48%
Present study	72.7%	9.9%	18.18%

Bone marrow aspiration and biopsy findings

On bone marrow aspiration and biopsy examination, age-adjusted hypercellularity was found in all 11 cases in our study. Myeloid hyperplasia was also observed in all of these cases, with a mean M:E ratio of 10:1. Megakaryocytes were also increased in all cases, with hyperlobated forms seen in 2 cases [18.18%], dwarf forms seen in 7 cases [63.3%]. Similarly, Khonglah Y et al. [131] concluded that all 55 cases [100%] had hypercellular marrow with myeloid hyperplasia. Mean M:E ratio was 10:1. Megkaryocytic hyperplasia was observed in 71% of the cases [dwarf forms in 85%, and hyperlobated forms in 18% of the cases].

Thiele J et al [132] and Cervantes F et al [133] reported similar observations [Table 67]

Table 67 : Bone marrow aspiration and biopsy findings in CML cases

Authors	**% of patients with hypercellularity**	**Mean M:E**	**Blasts %**	**Megakaryocyte morphology**
Khonglah Y et.al [131]	100%	10:1	1-10%	Dwarf forms-85% Hyperlobated forms-18%
Thiele J et.al [132]	100%	12:1	1-27%	Dwarf forms-96% Hyperlobated forms-4%
Cervantes F et.al [133]	100%	8:1	1-16%	Dwarf forms-86% Hyperlobated forms-14%
Present study	100%	10:1	1-4%	Dwarf forms-63.3% Hyperlobated forms-18.18%

Essential thrombocythemia

Age and gender distribution

The majority patients with ET were in age group 60 -70 years (50.0%), mean age of 71 years. Equal distribution was noted with M:F ratio of 1:1. Similarly .a study by Thiele J et al [134], observed 208 individuals with a mean age of 67 years and M:F 1:1. A study by Fenaux P et al [135] , observed 173 individuals with a mean age of 60 years and an age range of 18-83 years gender distribution was discordant with M:F 1:1.3. Another study done by Gisslinger H et.al.[136] observed 259 individuals with a mean age of 57.4 years and an age range of 18-88 years and gender distribution with M:F 0.6:1 was discordant with our study. Table [68]

Table 68: Mean age and M:F ratio

Authors	Mean age [years]	M:F
Gisslinger H et.al [136]	57.4	0.6:1
Fenaux P et.al [135]	60	1:1.3
Thiele J et.al [134]	67	1:1
Present study	71	1:1

Clinical presentations and organomegaly

Generalized weakness [4, 66.7 %], fever [1,16.7 %] ,loose stools [1,16.7 %], and were the most prevalent complaints in our study. Similarly, the most prevalent presenting symptoms in a study by Gisslinger et al. [136] were constitutional complaints such as generalized weakness [80.2 %], malaise and fatigue [77.22 %], and weight loss [8.6 %]. Another study by Thiele J et al. [134] found that generalized weakness [86 %], malaise and fatigue [78.4 %] were more common presenting complaints while weight loss in 30 cases [14.42 %], and fever in 25 cases [89.28 %] were unusual presenting complaints.

Splenomegaly in patients with essential thrombocythemia in our study was observed in 1 patient [16.7%].This finding is similar with that of Gisslinger H et al. [136], who found 16.7% of patients had splenomegaly, and Barbui T et al. [137], who found that only 20% of patients had splenomegaly.

The findings in our study are disconcordant to those of Hehlmann R et al [138], who found splenomegaly in 42 % of cases, and Thiele J et al [134], who found splenomegaly in 52 % of cases [Table 69]

Table 69: Distribution of splenomegaly

Authors	**% of cases with splenomegaly**
Barbui T et.al[137]	20%
Gisslinger H et.al[136]	16.7%
Hehlmann R et.al[138]	42%
Thiele J et.al[134]	52%
Present study	16.7%

Hematological parameters

In our study anemiawas seen in 4 cases [66.67%] and elevated hemoglobin was seen in 2 cases [33.33%]. Thiele J et al.[134] found that none of the ET cases had elevated hemoglobin levels, [46 % had normal range hemoglobin and 54 % had mild anemia].

Also, in our study, all of the patients [100%] had peripheral thrombocytosis which is consistent with the findings of Gisslinger H et al [136] who found peripheral thrombocytosis in all 259 patients [100%]. Fenaux P et al.[135] found thrombocytosis in all 147 [100%] of their patients in another study. In our study, 3 out of 6 patients [50.0 %] had leukocytosis [TLC ranging from >11 x103/ul]. Similarly in another study, Fenaux P et al [135] found that 66/147 patients [45 %] had leukocytosis In another study, Thiele J et al [134] found that only 9% of ET patients had leukocytosis.

Bone marrow aspiration and biopsy findings

In our study, 6 [100%] of the patients had hypercellular marrow, with an increase in the number of megakaryocytes in all patients. Hypolobated and hyperlobated megakaryocytes were seen in all cases [1000%] . While, Thiele J et al. [134] found normocellular bone marrow in 90% of cases, with megakaryocytic hyperplasia in all cases. In another study, Fenaux P et al [135] found that bone marrow examination revealed normocellular marrow in 36% of cases and mildly hypercellular marrow with increased numbers of megakaryocytes in 64% of cases. In a study conducted by Helmann R et al. [138], 60% of the participants had increased bone marrow cellularity and 40% had normocellular marrow.

In our study we found JAK2V617F mutation in 4 out of 6 (66.6%) similarly in a study by Rumi, E et al.[139] and Gangat N et al.[140] observed JAK2V617F mutation in 50% and 64.9% respectively patients of ET

MYELOFIBROSIS

Age and gender distribution

Primary myelofibrosis was shown to be more frequent in age 70 to 80 years old, [3,60%]. With a M:F ratio of 4:1, there was a male predominance. Patil VR et al. [141] in his found that 29/50 patients were male and 21 were female, with a M:F ratio of 1.3:1. The most common age group was 60-70 years.

Clinical presentations and organomegaly

The most prevalent presenting complaints in our study were generalized weakness [100%], fever [50%], abdominal pain [40%]. The findings differed from those of Patil VR et al.[141] they reported that the most prevalent symptom of the presentation was pain/discomfort in the abdomen in 34 out of 50 cases [68 %], followed by fatigue or weakness in 25 out of 50 cases [50 %]. In another study by Tefferi A et al. [142] observed that weakness was seen in only 29% of cases, fever in 30%, and stomach pain caused by splenomegaly in 80% of cases. Our findings are also in line with WHO Hematopoietic and Lymphoid Tissues, 2017 revised edition [143], which mentions constitutional symptoms [weakness, fatigue, weight loss, etc.] in 50% of cases. Organomegaly was found in 20% patients with myelofibrosis in our study. Splenomegaly was seen in 1 case [20%], and hepatomegaly in 1 case .

Hematological parameters

The majority of patients in our study had anemia, with 3 [60%] had moderate anemia ranging from 8.1 to 10.7 g/dl and 2 [40%] had severe anemia with Hb 7.6 and 5.6 g/dl, respectively. The majority of the patients showed microcytic hypochromic anemia, with nRBCs seen on peripheral blood film.

In a study conducted by Thiele J et al. [144], significant anemia and a leucoerythroblastic blood picture were detected in all 60 patients [100%]. Barosi G et al. [145] concluded that the majority of patients [80.7%] had mild anemia with a leucoerythroblastic appearance. In another study by Tefferi A et al. [146] observed that mild anemia was a common finding in 38 % of patients.

In our study two [40%] patients showed variable leukocytosis with TLC >15x103/ul and 3 cases[60%] showed leucopenia (TLC <4 x 103/ul) . In a study by Barosi et al. [145] they reported that the majority of patients [64.3 %] had normal range TLC and just 25% had leukocytosis. The results of our study are in contrast to those of Patil et al. [141], they observed mild leukocytosis in all 50 cases [100%] with TLC of >15.3x103/ul.

In our study, the majority of the patients [60 %] had leucocytosis [platelet count >450 x103/uL. Thrombocytopenia was found in the 2 [40%] patients, with platelet counts <150 x103/ul. While in a study done by Cervantes F et al. [147] concluded that 53 % had a normal platelet count, 30.5 % had thrombocytosis, and 16.5 % had thrombocytopenia. Also in another study done by Tefferi A et al. [142] reported that the majority of people had normal platelet counts, with only 18% having thrombocytopenia.

Bone marrow aspiration and biopsy findings

In our study, dry tap was obtained and megakaryocytic hyperplasia was seen in the all the cases on bone marrow biopsy. Grade 2 to grade 3 fibrosis was detected in all cases, with grade 3 fibrosis in 2 cases [40%] and grade 2 in 3 cases [60%]. Findings were concordant with study conducted by Pereira A et al. [148] they reported that all 51 cases [100%] showed megakaryocytic hyperplasia, with Grade 3 fibrosis in 54.9 %, grade 1 to grade 2 in 45 %. Similarly Guglielmelli P et al. [149] also observed that 36.7 % of the patients had fibrosis grade 1, 40.0 % had grade 2, and 23.3 % had grade 3.

POLYCYTHEMIA VERA

Age and gender distribution

There were 2 male cases of polycythemia-vera who were 65 and 63 years old. Similarly, Hasselbalch H et al. [150] in his study found that patients ranged in age from 19 to 87 years old, with majority in the 60 to 70 year old age group, with a mean age of 67 years and a M:F ratio of 1.2:1. In a study conducted by Sazawal S et al. [151] found that patients ranged in age from 35 to 78 years old, with the majority of patients being in their 30s and 40s, a mean age of 45 years, and a M:F ratio of 4:1. The current findings are in contrast to those of Cario H et al. [152], who found a small female predominance with a M:F ratio of 1:1.2, a mean age of 62 years, and an age range of 35 to 85 years. [Table 70]

Table 70: Distribution of age and gender

Authors	Mean age [years]	Range of age [years]	M:F
Hasselbach H et.al[150]	67	19-87	1.2:1
Sazawal S et.al[151]	45	36-78	4:1
Cario H et.al[152]	62	35.85	1:1.2
Present study	64	60-70	2:0

Clinical presentations and organomegaly

The most common complaints in our study were generalized weakness in 6 [46.15 %] cases and weight loss in 6 [46.15 %] cases, followed by thrombotic events resulting in symptoms such as headaches in 5 [38.46 %], vertigo in 4 [30.77 %], dizziness in 3 [23.08 %], malaise and fatigue in 4 [30.77 %] cases, paresthesia and abdominal pain in 2 [15.38 %] cases each. The results are similar to those of a study by Tefferi A et al. [153], which found that the most prevalent presenting complaints were weakness [54%] and weight loss [50%] followed by thrombotic events [headaches, vertigo, dizziness, etc.] in 18% of cases. Another study by Shaikh MS et al. [154] found that among 58 patients, weakness and fatigue were the most common presenting complaints [50 %], followed by weight loss in 10.7% of cases and thrombotic events in 7.1 % of cases. Also in a study done by Usman M et al. [155] found that 46.1 % of cases exhibited generalized weakness, with 38 % having headaches, hypertension, and other thrombotic complications.

The majority of the patients in our study showed splenomegaly [11, 84.62 %], with the majority of them having mild splenomegaly [7, 53.85 %]. Splenomegaly was found in 68.8% of patients in a study by Vannucchi. AM et al. [156] In another study done by Macmullin et al. [157] found that splenomegaly was present in 80 % of the cases.

Hematological parameters

Both patients in our study had hemoglobin levels of more than 16 g/dl, Tefferi A et al. [153] found that all patients had hemoglobin>15.8g/dl in their study. Thiele JM et al. [158] in his study found that all 362 patients had hemoglobin levels more than 16.5 g/dl. All 58 patients in another study by Shaikh et al. [154] had hemoglobin> 16.5g/dl, Usman M et al. [155] had all patients with hemoglobin of >16.2 g/dl.

In our study, platelet counts of both pateients were within normal range while in a study done by Tefferi A et al. [153] found 44/63 patients [65.15 %] having thrombocytosis, with platelet counts ranging from 493 to 1345x10^3/uL. Also in another study conducted by Vannucchi AM et al. [156] found that 65 % of cases had platelet counts ranging from 567 to 1248x10^3/uL.

Bone marrow aspiration and biopsy findings

In our study on examination of the bone marrow, all of the patients exhibited hypercellular bone marrow [100%]. The mean M:E ratio was 1.7:1. Megakaryocytic hyperplasia and trilineage hyperplasia were present in both patients. In a study done by Thiele JM et al. [158] observed hypercellular marrow and trilineage hyperplasia [panmyelosis] in all 360 cases. Similarly in another study by Thiele J et al. [159] reported all 86 patients [100%] had panmyelosis. Megakaryocytic hyperplasia was found in 98% of patients, with pleomorphic and atypical megakaryocytes and clustering in 51% of cases.

MYELODYSPLASTIC SYNDROME

A total of 12 patients were given a diagnosis of MDS (5.8%) in the present study. This is comparable with 9.23 % of cases of MDS observed by Janaki, M et al[160]. A study done by Maharjan D et.al [107] observed 10.16% cases of MDS . In a study done by Chandra H et al [102] there were (1.2%) cases of MDS. In a study by M S Sulakshana [103] observed 2% cases of MDS . While in the study conducted by Manion EM, et al [104] found 32.5% of cases with MDS and study by Teke HU et al [105] observed 27.2% cases of MDS which is higher than our study. Generalized weakness was seen in all cases of MDS patients in our study. However Khalifa M et al.,[161] had shown that only 81% of patients respectively were symptomatic. At presentation, the most common laboratory finding was anemia which was seen in all patients with MDS. In the present study

macrocytic anemia was commonly seen in patients of MDS (n=8,66.6%) . Microcytic hypochromic anemia (n-2,16.6%) and normocytic normochromic anemia(n-2,16.6%) was rarely associated with MDS. Study by Saba HI et al [162] observed only 9% of MDS cases had anemia. In the present study Pancytopenia was associated with 50% of MDS patients. However study by Dewulf G et al.[163] had shown a lower association of pancytopenia with MDS patients , accounting for 18% . In the bone marrow, the minimum diagnostic criterion for MDS is dysplasia in >10% of any of the myeloid lineages and less than 20% blast cells of all nucleated cells in the bone marrow unless there are cytogenetic abnormalities suggestive of the diagnosis of MDS as per the World Health Organization (WHO).

The dysplastic features commonly observed in MDS are megaloblastosis, multinuclearity, nuclear budding, intranuclear bridging, karyorrhexis and karyopyknosis and hypolobated , hyperlobated megakaryocytes. . In the present study, in MDS patients, multilineage dysplasia (91.6%) was more common than single lineage dysplasia (16.6%). This is similar with the study by Dewulf G et al.,loc.cit [163] who observed similar findings in MDS patients , multilineage dysplasia (73 %) was more common than single lineage dysplasia (10 %). However Dewulf G et[163] had encountered only 8% cases with refractory anemia with excess blasts(RAEB) in their study; while in our study no patient was diagnosed with refractory anemia with excess blasts (RAEB) . Similarly in a study by Mohanty P et al [164] observed abnormal erythropoiesis, myelopoiesis and megakaryopoisis showing dysplastic features along with abnormal localisation of immature precursors (ALIP) in BM biopsy.

CHRONIC LYMPHOCYTIC LEUKEMIA

In our study (n=12, 5.8%) of case were diagnosed as CLL similarly study by M S Sulakshana et al [103] observed 6% cases of CLL. In other studies , Teke HU et al [105] and Chandra H et al [102] observed 3.5% and 0.6% respectively in elderly patients. The peripheral smear showed absolute lymphocytosis >5x10^9/L. Bone marrow was infiltrated by 50% or more lymphocytes. Trephine biopsy was hypercellular. Diffuse pattern of marrow infiltration by lymphocytes was seen in 3(25%) patients , interstitial in 3(25%) , nodular in 2(16.6%) and mixed in 4(33.3%) patients while in a study conducted by Karam MN, et al.[165] 53 (50.0%) patients had interstitial distribution of lymphoid cells, 17 (16.0%) patients had nodular , 14 (13.2%) patients had mixed pattern, and 22 (20.8%) patients had diffuse pattern .

NON HODGKIN'S LYMPHOMA:

In the present study,n=10, 4.8% cases showed infilterate into bone marrow by Non Hogkin's lymphoma cells who were already diagnosed cases of lymphoma on lymph nodes. Similarly, in a study conducted by Teke HU et al [105] observed 6.3% cases of NHL in their study. While in studies by Chandraet al.[102], Gulati A et al [5] observed higher number of cases 10.8%, 14.8% respectively of NHL. In a study by Bairey O et al.[166] observed in 23 % cases of NHL bone marrow involvement was seen in elderly with age >80 years old .

In our study further subdivision was made based on further investigations (IHC, flowcytometry, SPE). There was one case of mantle cell lymphoma , three cases of diffuse large B-cell lymphoma which showed marrow infilterate, three cases of lymphoplasmacytic lymphoma one case of marginal zone lymphoma and two cases of hairy cell leukemia.

In a study by Sharma M et al.[167] , observed HL in elderly comprised 18.67% of the total HL patients and majority were male patients, and the

mean age of presentation was 65.9±5.6 years. Histology-wise, mixed cellularity classical hodgkin's lymphoma and nodular sclerosis classical Hodgkin's lymphoma were equally represented (30.76%). Only one patient had bone marrow involvement. CD30, CD15, and CD20 positivity was seen in 84.61%, 50%, and 26.92% of cases, respectively. Similarly in our study we observed one case of classical hodgkin's lymphoma. In a study by Sharma D et al [168] also observed Hodgkin disease in 1 (4.7%) in elderly patients. While in studies by Chandra, et al.[102], Gulati A et al.[5], M S Sulakshana et al [103], Teke HU et al [105] and Manion EM, et al [104] , no case of hogkin lymphoma was observed.

In our study showed CD20, CD30 and EBV-LMP1 positivity ,similar result of CD20 and CD30 positivity were seen in study of Sharma M et al[167].

HAIRY CELL LEUKEMIA

In the present study, 2 cases (0.9%) were diagnosed as hairy cell leukemia in the elderly patients on bone marrow aspiration and biopsy. Similarly, study by Teke HU et al [105], observed hairy cell leukemia in 1 case (0.9%). In our study, dry tap was obtained on bone morrow aspiration in both cases. Similarly study by Konkay K et al.[169] , observed dry tap in 10 cases (83.3%) of hairy cell leukemia and variable cellurarity was seen on bone marrow biopsy in 11 case and in one case hypocellularity was observed. In our study, bone marrow biopsy showed hypercellular marrow exhibiting sheets of lymphoid cells having hyperchromatic oval to indented nuclei and clear cytoplasm in both giving fried egg appearance and other normal hematopoetic elements were depressed.

ACUTE LEUKEMIAS

In the present study 16 cases with male preponderance (M:F- 2.2:1) were diagnosed as acute leukemia. These patients presented with weakness (93.8%) and loss of weight (6.3%). On peripheral blood film normocytic

normochromic RBC picture was seen in most of the cases (15 cases,93.8%) followed by macrocytic RBC picture (9 cases,50.0%) and microcytic RBC picture (7 cases,31.3%). In the differential leucocytic count, blasts were seen in majority of the cases (93.8%), neutropenia was seen in 2 cases (12.5%) and thrombocytopenia in 15 cases (99.8%).

In our study, AML accounted for 3.8% cases similar to study conducted by Manion EM, et al [104] while study by Teke HU et al observed higher numberof AML cases i.e 14.9%.

In the present study, 7 cases(3.3%) were diagnosed as ALL, simialry in studies by Chandra, et al·[102] and Gulati A et al [5] observed 3.8% and 4.8% cases of ALL in elderly population who underwent bone marrow examination. While in the study by Teke HU et al[105], observed ALL in only 1 cases (0.9%) in elderly population while study conducted by Manion EM et al[104] observed no case of ALL.

In adults, the tumors most often seen metastasizing to bone marrow are carcinomas of the prostate gland, breast, lung, thyroid and kidney. In our study, we found a case each of prostate carcinoma ,breast carcinoma and carcinoma lung metastasizing to bone marrow. Similary in a study by MS Sulakshana et al.[103] observed a case each of prostate carcinoma and renal cell carcinoma clear cell variant metastasizing to bone marrow.

While in a study by Chandra H et al [102] observed higher number of cases which metastasis to bone marrow.Metastasis was observed in eight cases with the most common metastasis being from prostatic adenocarcinoma.

Chronic myelomonocytic leukemia was seen in single case who presented with chief complaints of generalized weakness and leg pain. Patient had moderate microcytic hypochromic anemia on pbf. Leucocytosis with absolute monocyte count 4.7x10^9/L was observed. Platelets were adequate in number. Bone marrow aspiration and biopsy revealed hypermocellular marrow with depressed erythroid series, normoblastic

maturation & features of dyserythropoiesis upto 6% . Myeloid hyperplasia with prominence of monocytes & monocytoid precursors constituting 15% of all nucleated cells. Prominence of blasts constituting 8% of all nucleated cells were seen and megakaryocytes were adequate with M:E ratio 6.4:1. While in a study by Teke HU et al[105]observed 3 cases (2.6%) in his study who were diagnosed as CMML.

NON-NEOPLASTIC CASES

IDIOPATHIC THROMBOCYTOPENIA

There were 27 cases of ITP with age more than 60 years and male to female ratio of 1.7:1. Similar to study done by Mancuso S et al [170], who observed in his study mean age of ITP patients as being 74.86±6 year with a male to female ratio 1.2:1. In our study, bleeding manifestations in our study was seen in 29.6% cases while in as studies conducted by Mancuso S et al [170] and Andres E et al [171] observed in their studies higher number of people with bleeding manifestations 56% and 59% respectively.

In our study, peripheral blood smear showed normocytic, normochromic anaemia with peripheral thrombocytopenia (range 10 - 70 x 109/ l) in all cases of ITP.. Bone marrow aspiration showed normocellular to hypercellular marrow. Erythroid series showed normoblastic maturation and myeloid precursors showed an orderly cell maturation .Megakaryocytes were adequate in 16 cases and 11 cases showed prominence with few young forms. In a study by Jubelirer SJ et al [172] the bone marrow was normocellular with normal or increased megakaryocytes in 82 cases and in four patients, the bone marrow revealed a normocellular marrow but decreased megakaryocytes.

MEGALOBLASTIC ANAEMIA

In the present study, 11(5.3%) cases were diagnosed with megaloblastic anemia with male to female ratio was 1:1.7 with female preponderance. While in a study by Anand DR et al.[106] ,observed megaloblastic anemia being the most common subtype and study by Gulati,et al [5] also found megaloblastic anemia being the most common diagnosis in elderly population similar to study by Das R et al.[173]

ANEMIA OF CHRONIC DISORDER

Anemia of chronic disorder was seen in 9 (4.3%) cases with male to female ratio of 2.5:1 and majority were in age group between 60 -70 years (66.6%) followed by 70-80 years (22%) and >80 years (11%) while in a study by Sahin S et al [174] observed,in the elderly participants with malnutrition or malnutrition risk, the most common cause of anemia was anemia of chronic disease 57.1%.

APLASTIC ANEMIA (n=8)

Eight cases(3.8%) of aplastic anemia were observed. Male preponderance seen with 5 cases male (62.5%) and 3 cases (37.5%) female. All patients presented with anemia. Leucopenia with neutropenia was seen in 75% (6 cases) and thrombocytopenia was present in 87.5% (7 cases).

In a study by Anand DR, et al [106] aplastic anemia was diagnosed in two cases (1.2%) and both were done on biopsy. This finding was similar to study by Gulati A et al. [5] and Bashir N et al. [175] (3.6% and 3.1%) respectively. Bone barrow biopsy is of utmost importance in diagnosing aplastic anemia as it is an accurate tool to asses marrow cellularity.

HEMOPHAGOCYTIC LYMPHOHISTIOCYTOSIS

In our study, 2.9% cases were diagnosed with HLH. Similarly, Altook R, et al [176] reported 2 cases in elderly and concluded HLH is a rare entity in the elderly and is associated with significant mortality. A case of HLH was reported by Mulkareddy V et al [177], who was 69-year-old male, presented with fever for one week and on bone marrow similar findings were observed as in our study.

IRON DEFICIENCY ANEMIA

A 69 year old male, presented with chief complaints of generalized weakness and loss of appetite. Low serum iron was observed (50mcg/dl). Microcytic hypochromic picture was seen on PBF. Bone marrow aspiration and biopsy revealed normocellular marrow with erythroid prominence and normoblastic maturation. Micronormoblasts were observed in the marrow. Myeloid precursors exhibit orderly cell maturation and megakaryocytes were adequate. Perl's stain for iron showed absent iron stores in the aspiration smears. While in a study by Chandra H et al,[102] observed higher number of cases with iron deficiency anemia 11.5%.

LEUKEMOID REACTION

Five cases with age ranging from 60-80 year, with male to female ratio-3:2, similarly study by Potasman I,et al [178] observed leukemoid reaction in elderly age group with median age was 75 years and female preponderance. In our study, they presented with fever and one with burning micturition. On peripheral blood smear, there was leucocytosis with neutrophila. Bone marrow aspirates showed hypercellular marrow with myeloid prominence with an orderly cell maturation . Megakaryocytes were prominent in 3 cases. LAP score was performed and it was high in all cases.

HEMOLYTIC ANAEMIA

Four cases of hemolytic anaemia with subjects aged more than 60 year and male to female ratio 3:1, presented with generalized weakness and in one patient had melena. Hepatomegaly was seen in 1 case and spleenomegaly in 2 cases.Anemia was mild to severe with Hb ranging from 5.6-8.9 g/dL (mean -7.9g/dL). Leucocyte count was within normal limits except one case having mild leucocytosis. Thrombocytopenia in 3 cases and in one case platelet count was within normal range. PBF showed moderate anispoikilocytosis with presence of macrocytosis, polychromasia along with schistocytes. Corrected reticulocyte count was increased in one case and in other it was within normal range. In a study by Zulfiqar AA et al[179] observed hemolytic anemia in 10 elderly people with their mean age was 85.6 (range 76–93); the female:male sex ratio was 2.7. Severe clinical manifestations related to hemolytic anemia (chest pain, tachycardia, cardiac failure, confusion, excessive fatigability) was reported in 70%, with transfusion required in these individuals. Mean hemoglobin level was 8.2 g/dL (range 5.8–12.3 g/dL). Also in a study by Maquet J, et al[180], observed the incidence of AIHA (primary or secondary) was more than ten times higher in the elderly and very elderly as compared with people <50 year-old. In this study the median age was 69 years and 55.6 of the patients were female.

Bone marrow aspirate showed hypercellular marrow with erythroid hyperplasia with normoblastic & megaloblastic maturation. Leucopoiesis showed orderly cell maturation and megakaryocytes were adequate. Iron staining showed adequate iron in all cases except one which had reduced iron stores. Biopsy section and imprint smears gave no additional information. Further investigations revealed ANA positivity and indirect coombs test was positive in one case and final diagnosis was made as autoimmune hemolytic anemia.

HYPEREOSINOPHILIC SYNDROME

In our study,two cases (73 year old, male and 60 year, old female) , presented with fever and other with generalized weakness. On PBF, normocytic normochromic RBC picture with marked eosinophillia (45% and 70% eosinophils respectively) was seen. Bone marrow aspirates showed hypercellular marrow with marked increase in eosinophilic precursors (45% and 60% respectively). No prominence of blasts was seen on bone marrow aspiration and biopsy. Similarly a case of hypereosinophilic syndrome was reported by Khalid F et al [181] .in a elderly patient. Similarly in studies by Chandra H et al [102], Gulati A et al[5] and Teke HU et al [105] observed HLH in 2.5, 0.9% and 0.9% cases in elderly respectively .

GRANULOMATOUS INFLAMMATION

A 62 year old male, presented with weakness, loss of appetite, backache and loss of weight. On PBF, leucocytosis with neutrophilia was seen. Bone marrow aspirates showed hypercellular marrow with myeloid series showing orderly cell maturation.Erythropoeisis showed normoblastic maturation and megakaryocytes were adequate. On bone marrow biopsy granulomas was seen . All the normal hematopoetic elements exhibit normal morphology and maturation. 20% of ZN stain for AFB was negative.

RED CELL APLASIA

A 67 year old female a known case of thymoma, presented with anemia,. On pbf, normocytic normochromic anemia was seen. Bone marrow aspirate and biopsy showed hypercellular marrow with myeloid series showing orderly cell maturation, erythropoisis was markedly suppressed and megakaryocytes were adequate. We could not follow up the patient as patient died. Similarly a case was reported by Mandal S et al [182], who observed pure red cell aplasia in a 73-year-old man.

LEISHMANIASIS

A single case of leishmaniasis was also discovered in a 67yearold male, despite the fact that it is considered nonendemic in this region. In a study by Chandra H et al [102] also observed leshmaniasis in one patient with age 61 year old. In a study by Gulati A et al [5] observed Leishmania donovani infestation in a 74 years male patient who presented with PUO. As a result, even in clinically unsuspected cases from nonendemic areas, Leishmania donovani bodies should be diligently searched in bone marrow in the geriatric population. Even in nonendemic areas, family medicine and primary care practitioners should look for leishmaniasis in their differential diagnosis.

NORMOCELLULAR NORMOBLASTIC MARROW

In our study, 11 cases (5.3) of normocellular normoblastic marrow with male to female ratio of 1.75:1 and majority of cases in age group between 60 -70 years(72.1%) were observed. TLC of these patients were within normal limits in 54.54 % of cases and leucocytosis was seen in 45.36% of cases. Bone marrow aspirates showed normocellular marrow with myeloid series showing orderly cell maturation, erythropoisis was normoblastic maturation and megakaryocytes were adequate. While in studies by Gulati A et al [5] , Teke HU et al[105] observed higher number of cases with normocellular normoblastic marrow in elderly 16.8% and 14 % respectively.

This study had a few limitations:

- Follow up was not possible in all the cases.
- Genetic workup could not be done in all the cases due to poor patient compliance. Therefore, further classification of AML depending on genetic abnormalities and genetic risk stratification of multiple myeloma could not be performed.

Future prospective of this study is that all the geriatric patients with low blood counts should be evaluated for hematological disorders with the help of peripheral blood smears and bone marrow examination.

SUMMARY AND CONCLUSION

The present one year prospective study was conducted on geriatric patients in Pathology Department, DMCH, Ludhiana.

This study included a total of 206 cases and were analyzed with respect to clinical findings, hematological parameters and bone marrow features.

Of 206 cases included majority [n=130, 63%] were in the age group of 60 to 70 years of age group with age range of 60 to 92 years with mean age being 68.4 years.

Male preponderance was noted with Male:Female ratio of 1.6:1.

In this study, suspicion of plasma cell dyscrasia/ multiple myeloma (n=48,23% followed by pancytopenia (n=36, 17%) were the most common indication for bone marrow examination in elderly patients.

The most common clinical feature was generalized weakness seen in 151 cases(73.3%), followed by fever in 49 cases(23.7%)

Our study revealed that bone marrow done in geriatric patients, constituted 116 cases (56.3%) of neoplastic disorders and 90 cases (43.6%) of nonneoplastic disorders of the total 206 cases. So, out of 116 neoplastic disorders, 113 cases (97.4%) were hematological malignancies and 3 cases (2.5%) were of metastatic deposits of carcinomas.

We found that most common neoplastic disorder was multiple myeloma (34 cases) followed by myeloproliferative neoplasm (25 cases).

In our study, the most common non neoplastic diagnosis was idiopathic thrombocytopenic purpura (13.5%) followed by megaloblastic anemia (5.30%), aplastic anemia(3.8%) and anemia of chronic disorder (4.3%).

Malignancy risk increases with age, contributing to mortality and morbidity in the elderly. Bone marrow aspiration and trephine biopsy are important tools in the evaluation of elderly patients with hematologic and non-hematologic disorders. Combination use aids in the diagnosis of disorders and helps guide therapy..

The diagnostic yield increased further by correlating marrow findings with clinical parameters and ancillary tests.

Early diagnosis and treatment in these cases can significantly decrease the morbidity and mortality in these elderly patients. And diagnosis of plasma cell dyscrasias on bone marrow aspirations/ biopsies prompt for early institution of treatment resulting in reduced morbidity and mortality in such patients.

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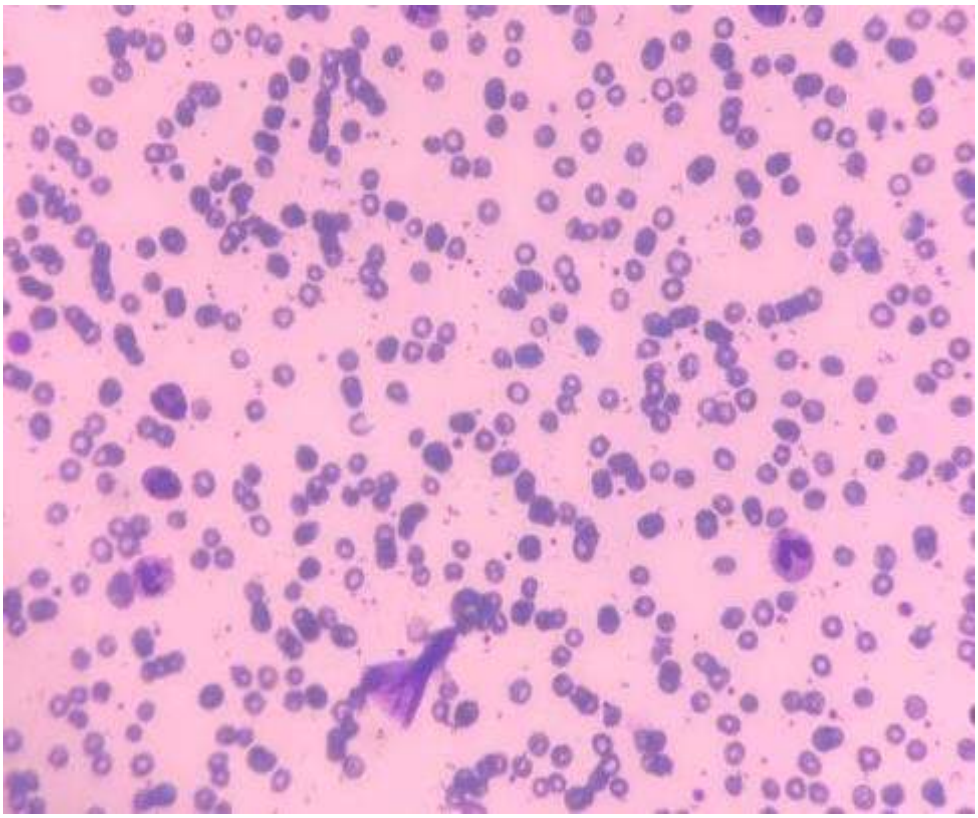
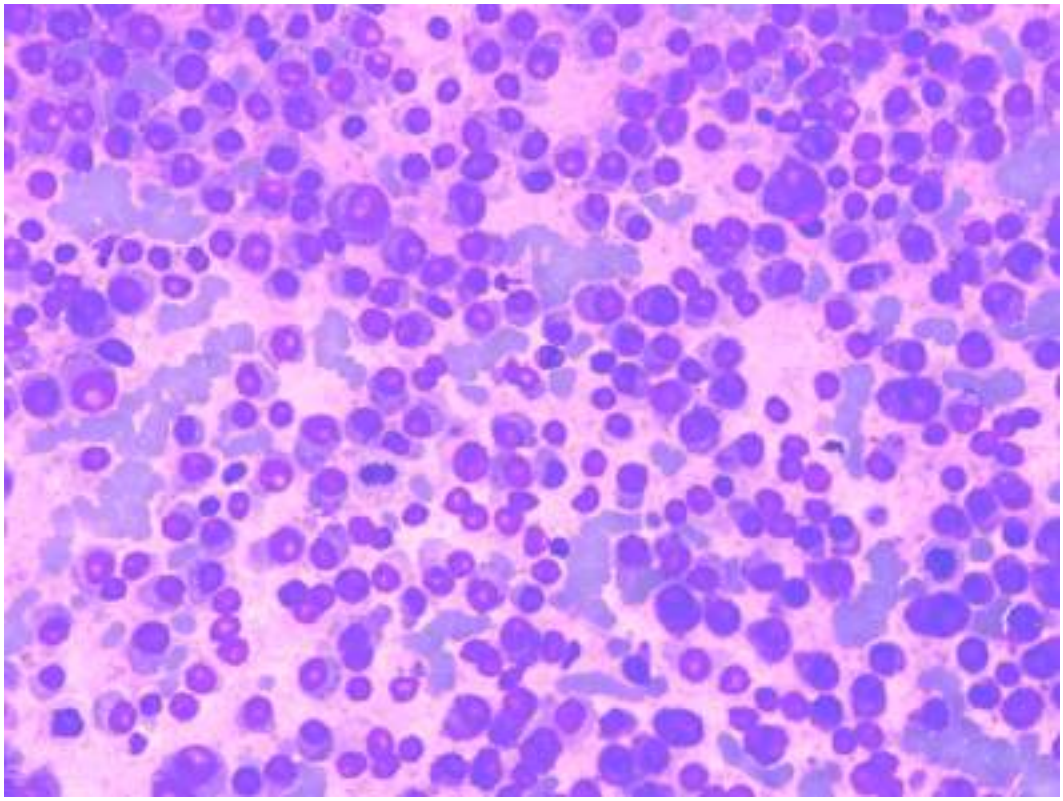
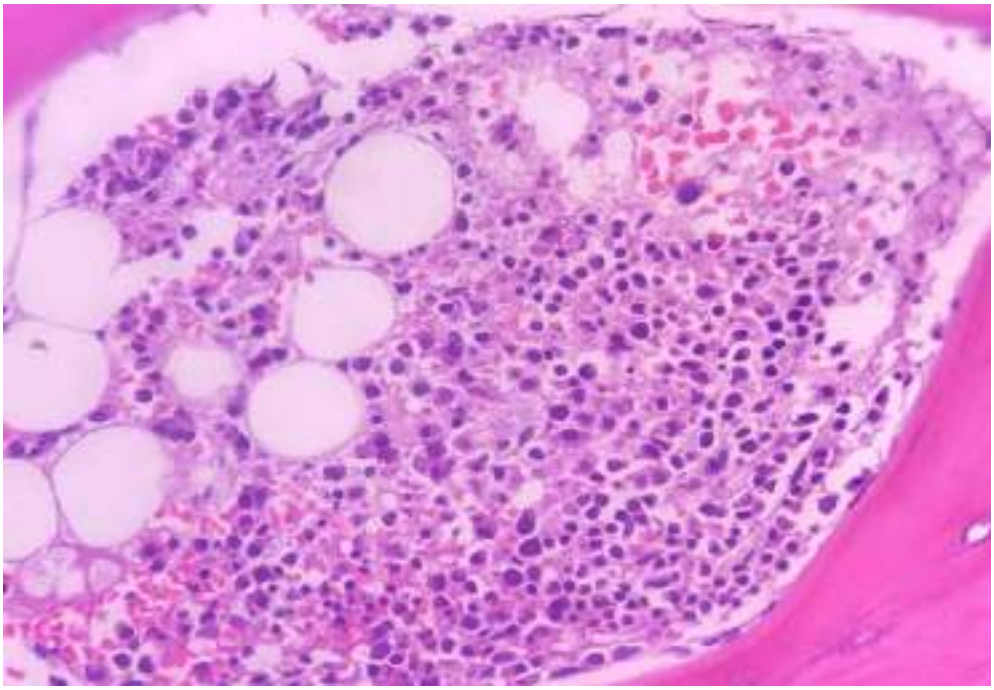


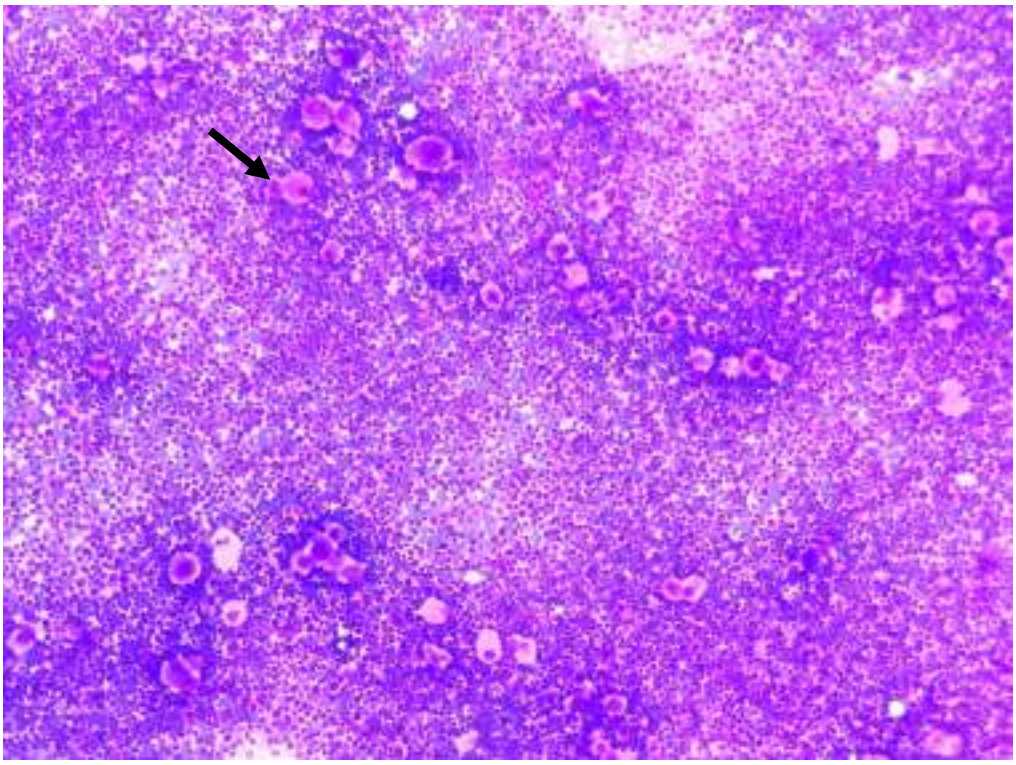
Picture 1 : Peripheral blood smear of 65 year old male showing rouleaux formation in case of multiple myeloma. [MGG stain 400x]



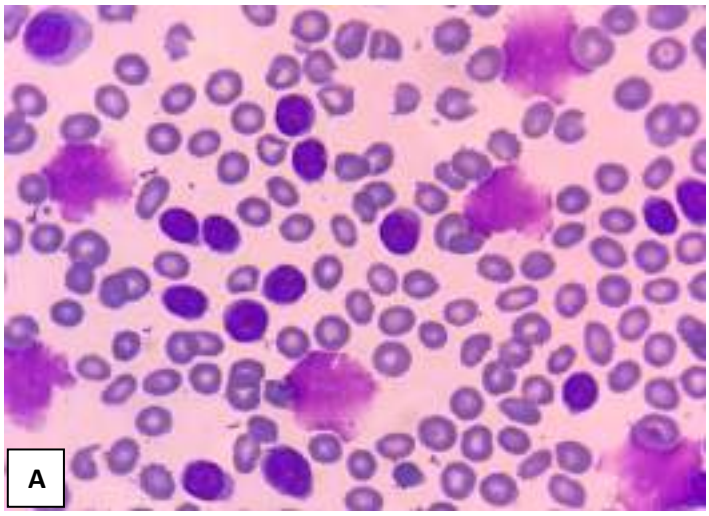
Picture 2: Bone marrow aspiration smear of 65 year old male showing plasma cells in case of multiple myeloma. [MGG 400x]

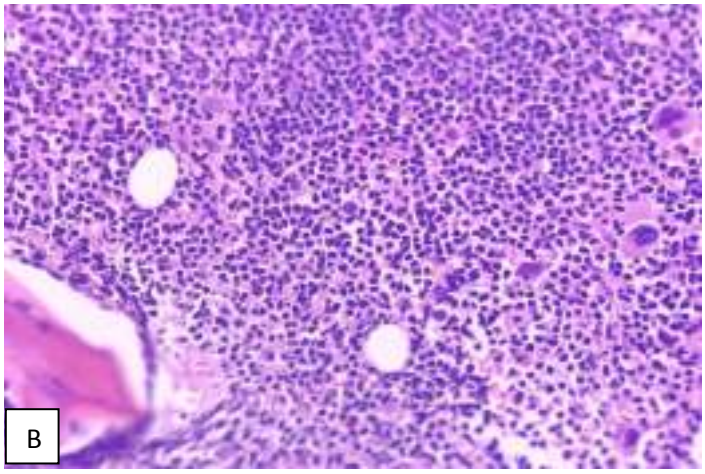


Picture 3: Bone marrow biopsy of 65 year old male showing nodular infiltration of plasma cells in case of multiple myeloma. [H&E 400x]



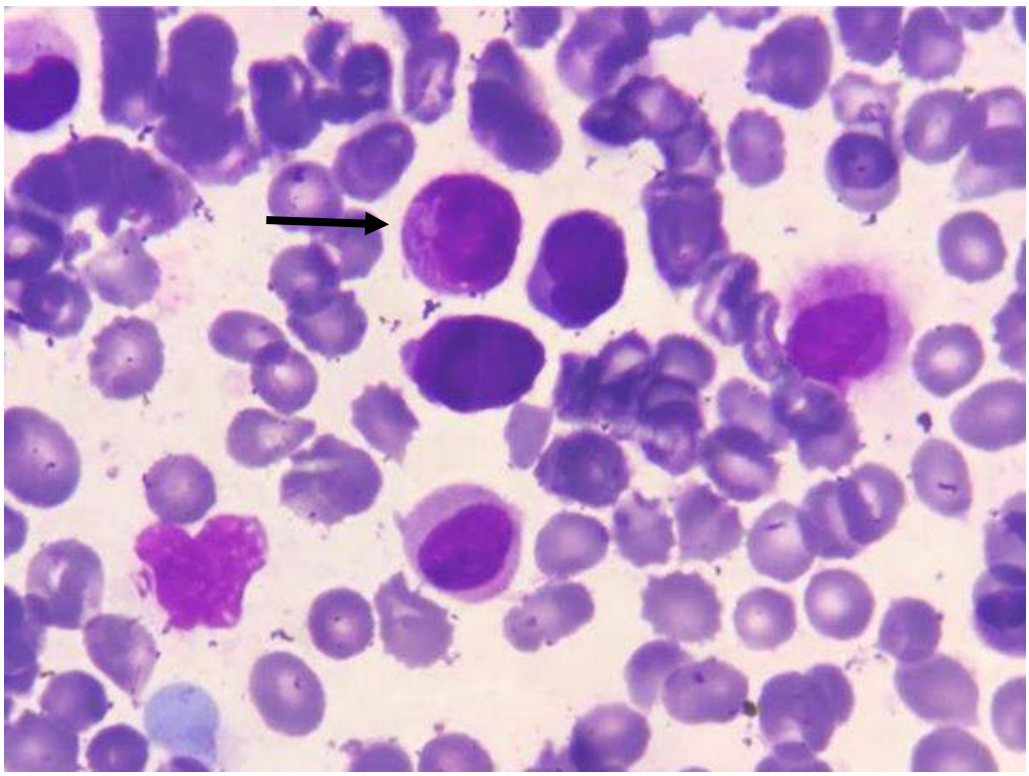
Picture 4: Photomicrograph shows bone marrow aspirate of 74 yr old, male,who was diagnosed with CML in chronic phase showing hypercellular marrow with marked myeloid and megakaryocytic hyperplasia along with prominence of dwarf megakaryocytes [black arrow]. [MGG 100x]



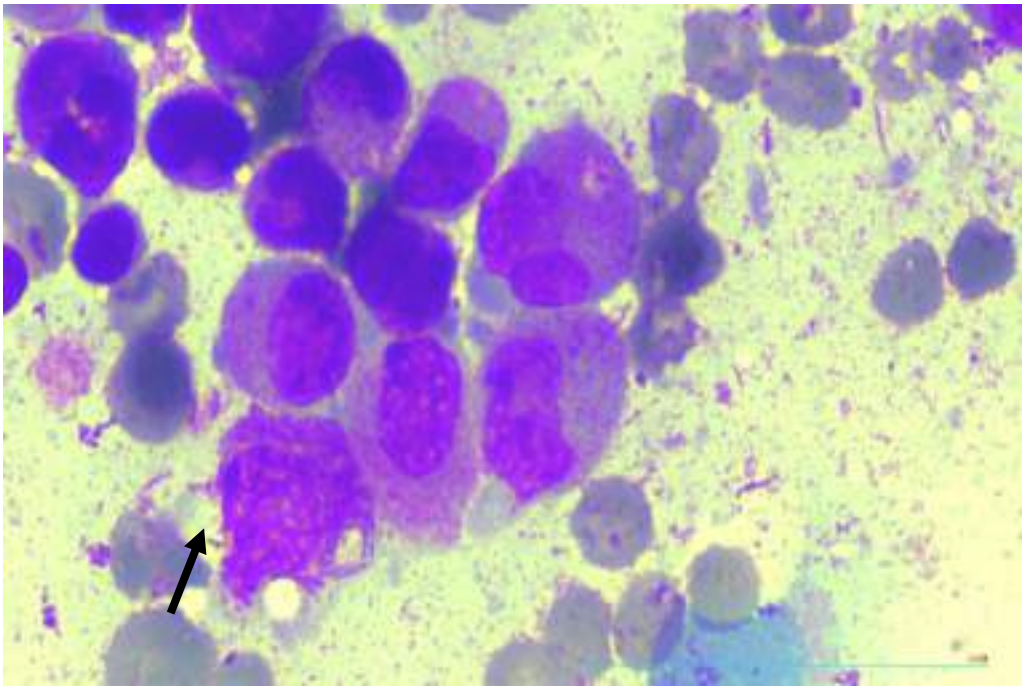


Picture 5: Chronic lymphocytic leukemia: A:Peripheral blood smear of 69yr old, male, showing lymphocytosis with smudge cells. [MGG, 1000x]

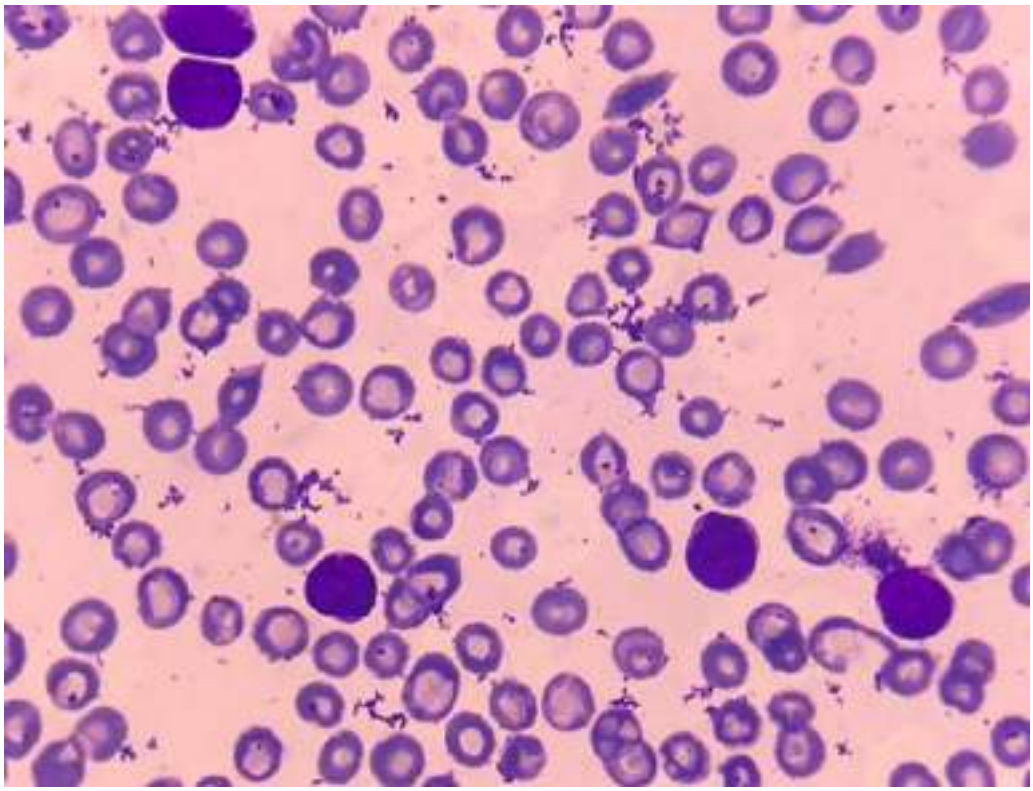
B: Bone marrow biopsy of the same patient showing diffuse lymphocytic infiltration by mature looking lymphoid cells . [H&E, 400x]



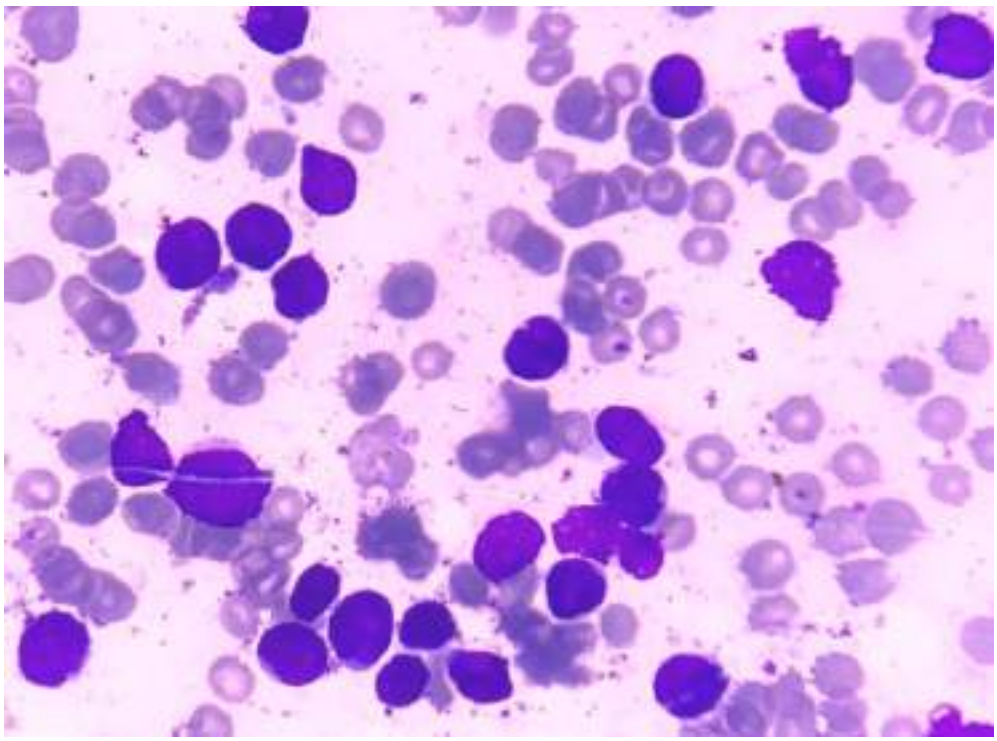
Picture 6: Acute myeloid leukemia: Peripheral blood smear of 69yr old, male, showing blasts with auer rods (black arrow). [MGG, 1000x]



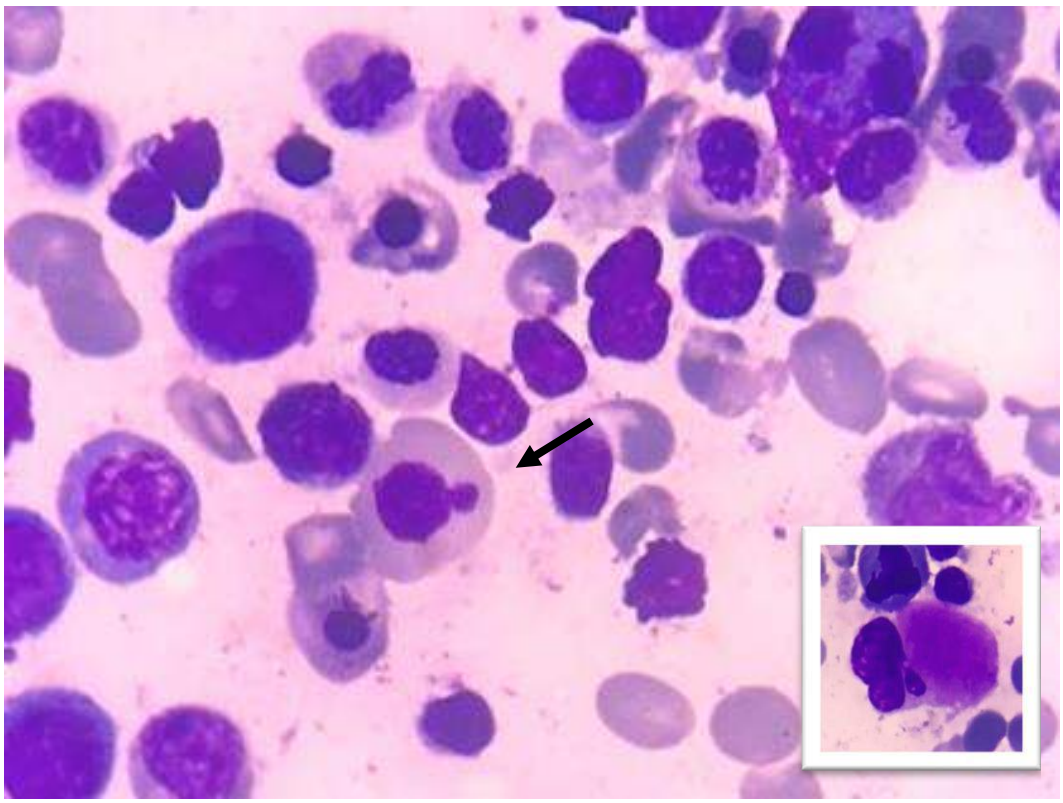
Picture 7: Bone marrow aspiration of 69 yr old, male diagnosed as acute myeloid leukemia shows blasts with auer rod [Black arrow]. [MGG, 1000x]



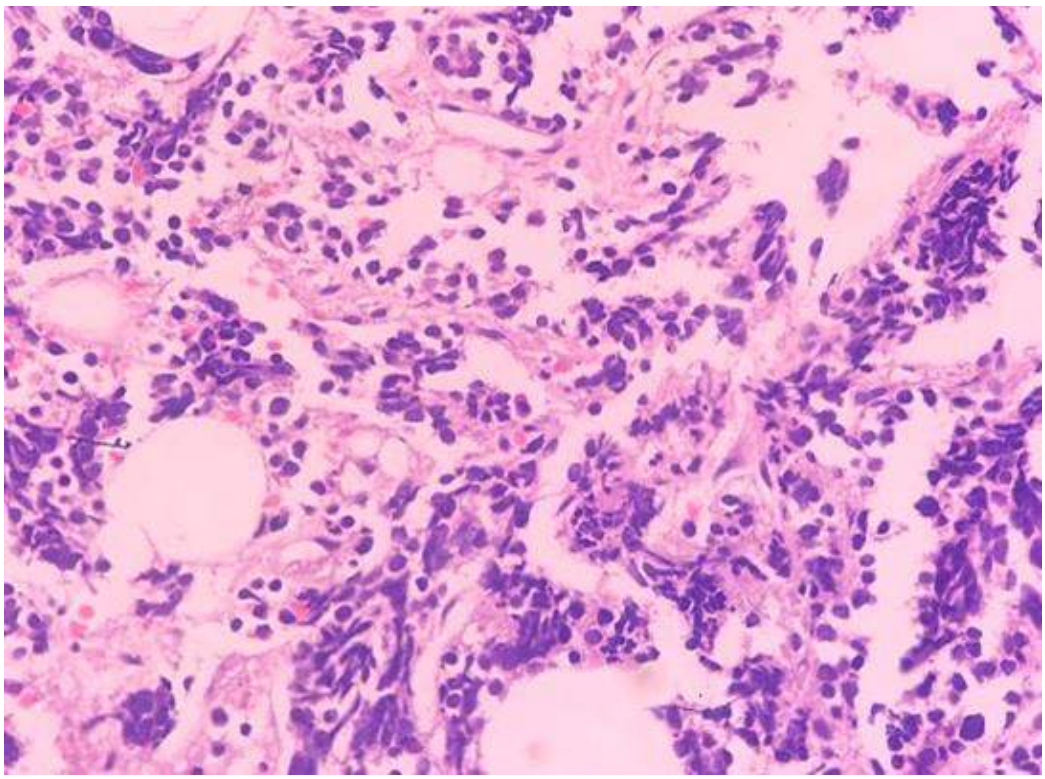
Picture 8: Acute lymphoblastic leukemia: Peripheral blood smear of 60yr old, female, showing blasts [MGG, 1000x]



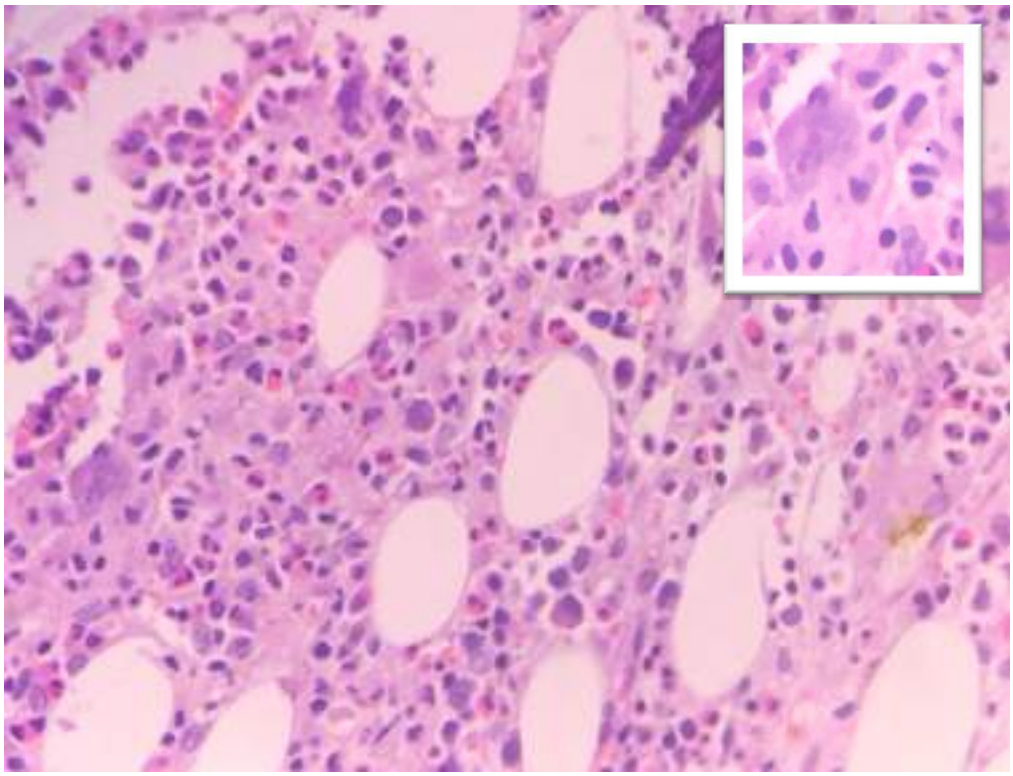
Picture 9: Case of acute lymphoblastic leukemia:: Bone marrow aspiration of 60yr old, female, showing blast infiltration. [MGG, 1000x]



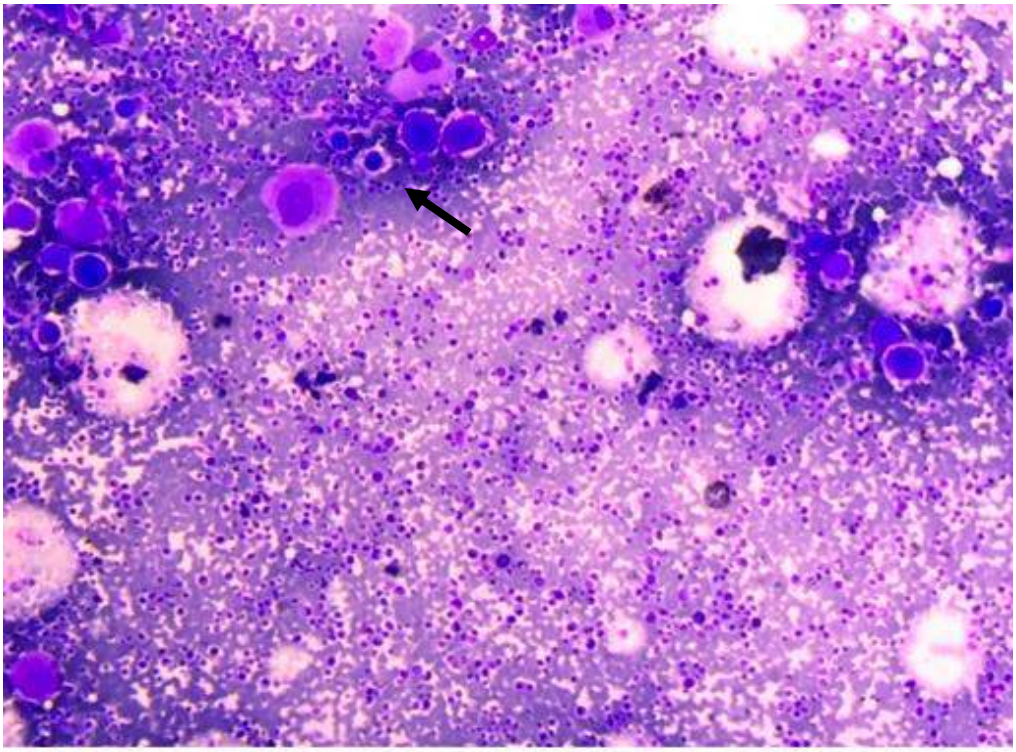
Picture 10: Bone marrow aspiration of 83 yr old, male diagnosed as myelodysplastic syndrome , showing erythroid dysplasia [black arrow] and megakaryocytic dysplasia(Inset) [MGG, 400x].



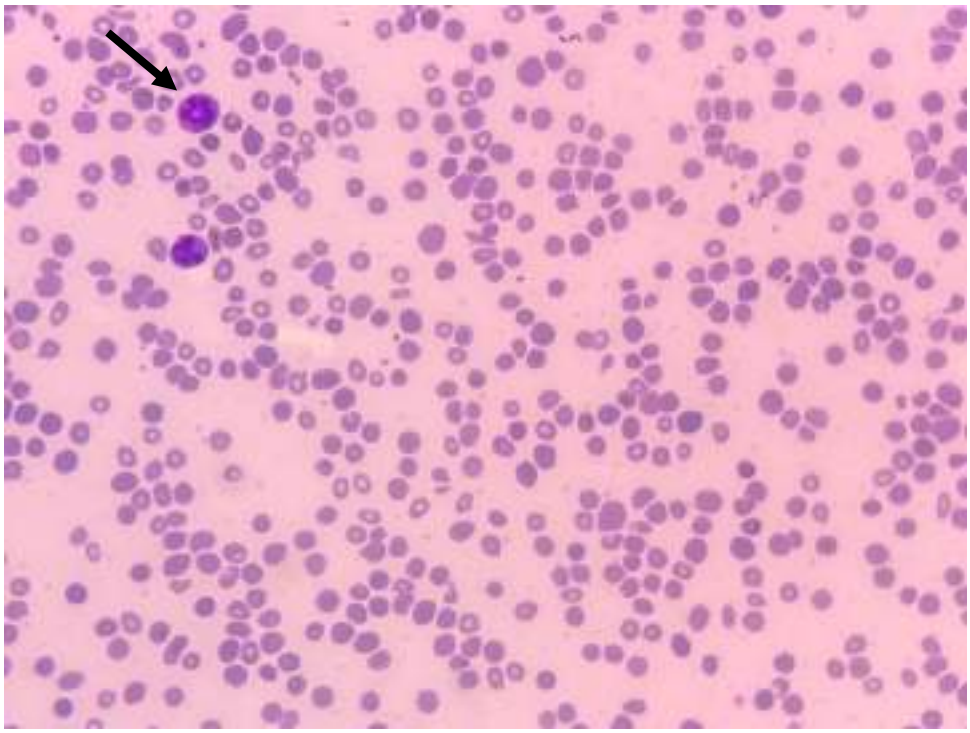
Picture 11: Metastatic deposits: Bone marrow biopsy of 67yr old, female, showing metastasis into marrow [H&E, 400x]



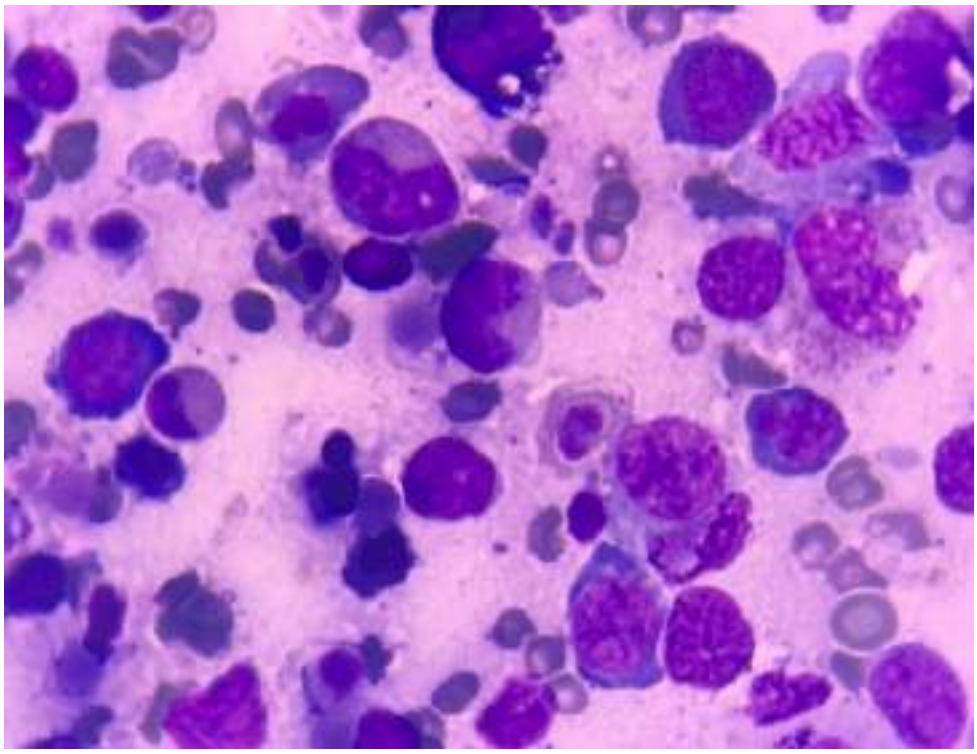
Picture 12: Case of Classic Hodgkin lymphoma: Bone marrow biopsy of 73yr old, male, showing RS cell [H&E , 400x]



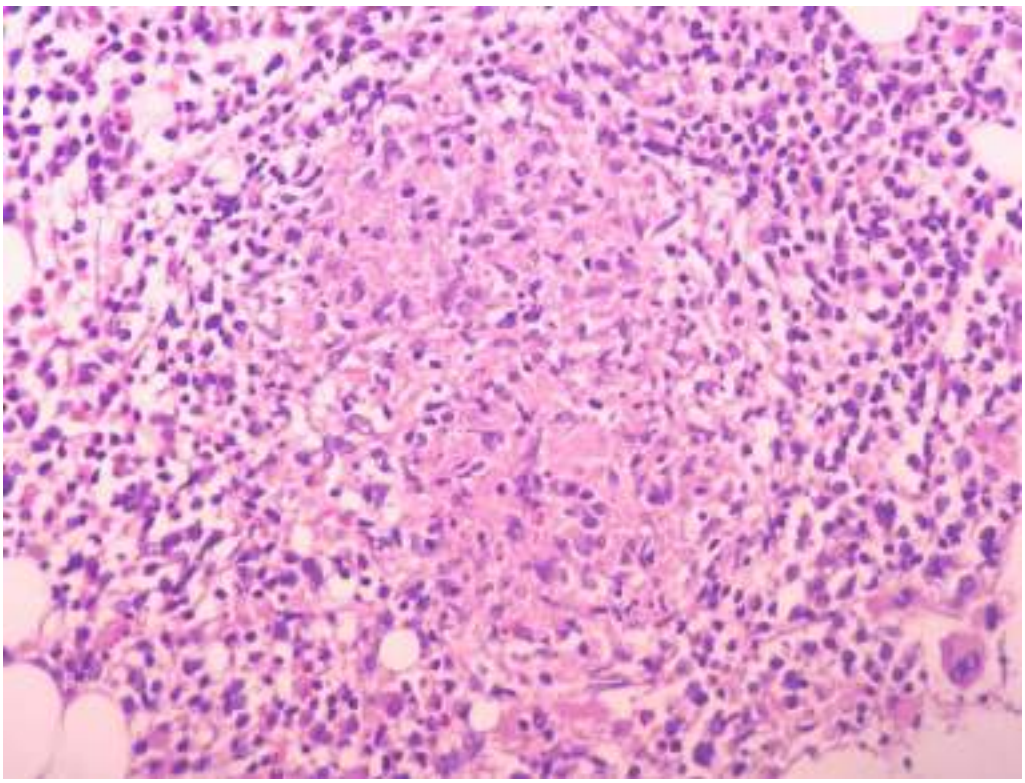
Picture 13: Bone marrow aspirate of 80 old, female, diagnosed as idiopathic thrombocytopenia showing megakaryocytic hyperplasia with young forms (Black arrow). [MGG , 400x]



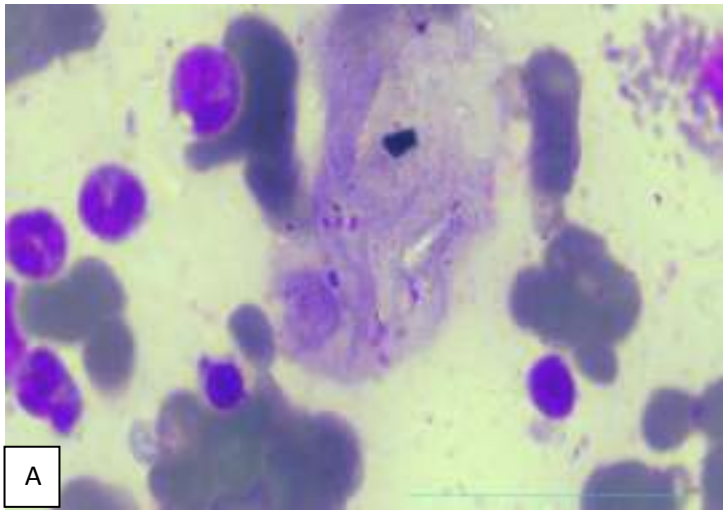
Picture 14: Megaloblastic anemia: Peripheral blood smear of 73 yr old, female, showing macroovalocytes and hypersegmented neutrophils (Black arrow)[MGG, 400x]

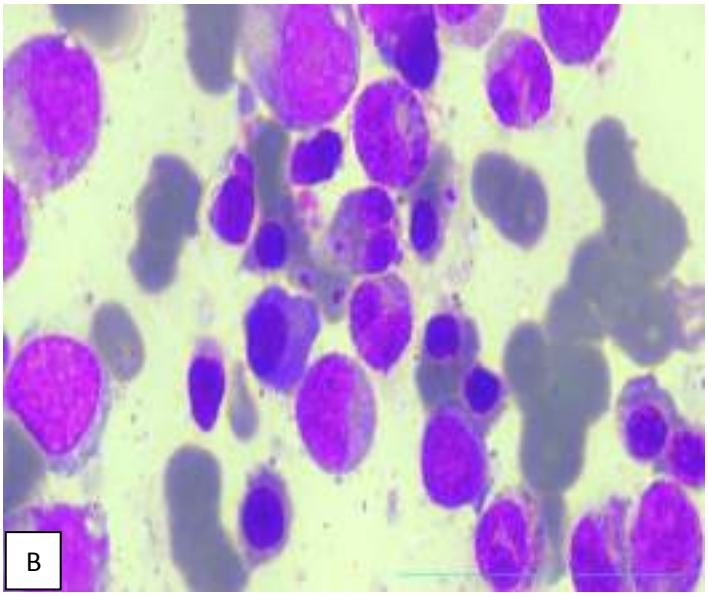


Picture 15: Megaloblastic anemia: Bone marrow aspirate smear of 62 yr old, showing megalobasts and giant myelocyte/metamyelocytes [MGG , 400x]

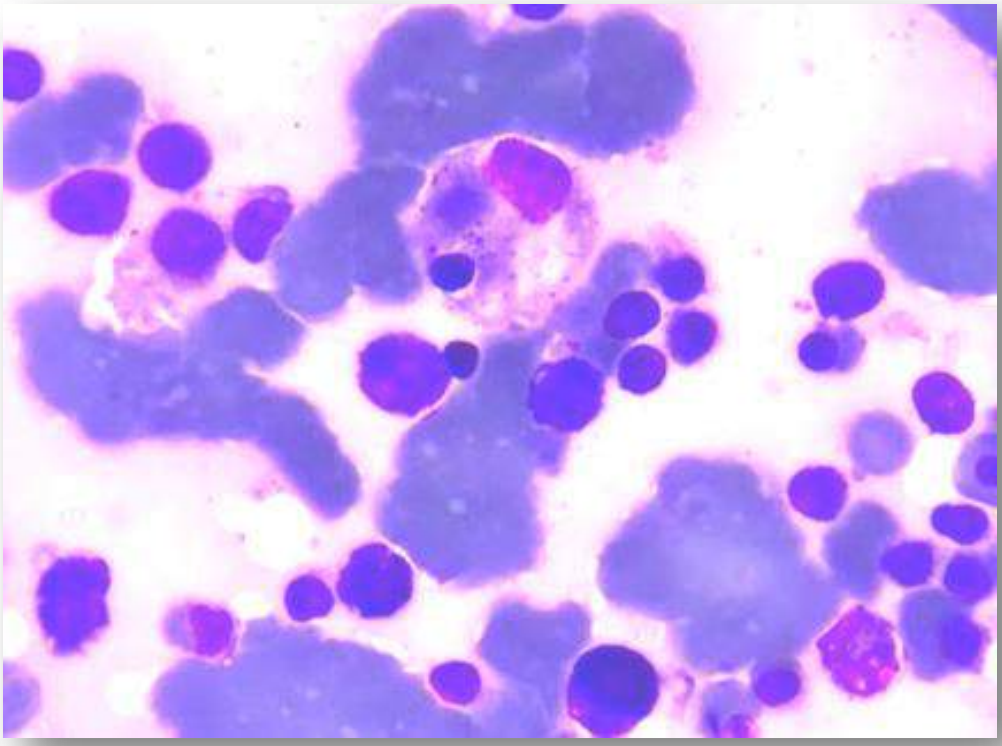


Picture 16: Bone marrow biopsy of 62 yr old, male, showing epithelioid cell granuloma [H&E , 400x]





Picture 17(A & B): Leishmaniasis: Bone marrow aspirate of 73yr old, female, showing LD bodies [MGG , 400x]



Picture 18: Case of hemophagocytic lymphohistiocytosis: Bone marrow aspirate of 67yr old, male, showing hemophagocytosis [MGG , 400x]

PROFORMA

S.No.: MRD:

Hematology No: Surg. Path No:

Name: Age:

Sex : Date:

Address: Phone no.

Chief presenting complaints:

Duration:
Past history:

Family history:
Personal history:
General Physical examination:
P/A examination:

Indication for bone marrow:

Hemogram :

PBF findings:

Radiological investigations: CT scan/ MRI/ Xray/ PET

Signature of Candidate **Signature of Supervisor**

Bone marrow aspiration

Site

Aspiration.

Cellularity

Erythropoiesis

Leucopoiesis

Megakaryocytes

Myelogram

M:E Ratio
Iron
Bone marrow aspiration diagnosis:

Bone marrow biopsy diagnosis:

Signature of Candidate **Signature of Supervisor**

Other relevant investigation: Serum Iron profile/ Serum B12/Folate

Other infective-etiology work up

Myeloma workup profile :

Cytogenetic studies:

Flowcytometry findings (if any):

IHC findings (if any):

Any other:

Final diagnosis:

Signature of Candidate **Signature of Supervisor**

S. No.	MRD No.	Hematology No.	Surg. Path No.	Name	Age	Sex	Date	Chief presenting complaints	Petechiae	Burning micturition	Haemoptysis	SKIN MANIFESTATION	Loose stool	Melena	Weakness	Abdominal pain	Anemia	Backache	FEVER	Shortness of breath	Loss of weight	Loss of appetite	PAIN	BLEEDING	COUGH	OTHER	Past history	Family history	Personal history	General physical examination
0	1036530	21-158	21-1907	R	60	M	03-01-2021	Weakness with pain in legs , Melena .	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	Y	N	N	N	-	-	-	-
1	1036316	21-165	21-1996	RP	61	F	03-03-2021	Fever, Weakness	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN, DM	-	-	-
2	282740	21-167	21-2046	RMD	83	M	03-04-2021	Weakness, Shortness of breath.	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	HTN, DM	-	-	-
3	1044083	21-177	21-2179	GS	73	M	03-08-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN	-	-	-
4	1044974	21-178	21-2199	M	73	M	03-08-2021	Weakness, Shortness of breath, Fever	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	-	-	-	-
5	1013222	21-180	21-2208	DDm	90	M	03-09-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	Smoking, HTN, DM	-	-	-
6	1040598	21-181	21-2209	RKR	66	M	03-09-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Post Permanent pacemaker implantation	-	-	-
7	322523	21-192	21-2421	M	78	F	15/3/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
8	191138	21-198	21-2486	JK	63	F	16/3/2021	Weakness, Fever, Bleeding on tongue	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	Y	N	N	HTN, DM, CKD	-	-	-
9	1041806	21-199	21-2507	RK	70	M	16/3/2021	Fever, Weakness	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
10	1054784	21-202	21-2531	BS	65	M	16/3/2021	Burning micturition	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
11	1054433	21-201	21-2510	KS	65	F	17/3/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	Pallor
12	1026672	21-205	21-2541	KR	63	M	17/3/2021	Dyspepsia, abdominal distension	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN, DM	-	-	-
13	1046573	21-207	21-2557	SDS	63	M	17/3/2021	Weakness, Loss of weight, Backache, difficulty in swallowing	N	N	N	N	N	N	Y	N	N	Y	N	N	Y	N	N	N	N	Y	DM	-	-	Pallor
14	1052006	21-208	21-2559	LK	68	F	18/3/2021	Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	HTN	-	-	Pallor, icterus
15	968698	21-211	21-2568	SK	68	F	18/3/2021	Weakness, Backache	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	K/C/o multiple myeloma	-	-	-
16	1055993	21-213	21-2583	PD	65	F	18/3/2021	Weakness, Loss of appetite	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	HTN	-	-	-
17	1056988	21-214	21-2605	VK	72	M	19/3/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN, DM	-	-	-
18	1058567	21-220	21-2657	PK	65	F	20/3/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	Pallor
19	1049669	21-222	21-2664	TL	65	M	20/3/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	DM	-	Alcoholic, Smoker	-
20	1061687	21-226	21-2735	MS	67	M	23/3/2021	Weakness, Fever, Shortness of breath	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	HTN, DM, Post kidney transplant	-	-	Pallor
21	1063196	21-229	21-3207	RD	77	F	24/3/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
22	1063228	21-230	21-2770	US	67	F	24/3/2021	Anemia	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	K/C/O Thymoma	-	-	-
23	1062966	21-231	21-2772	PS	65	M	24/3/2021	Multiple lacunar infarcts, acute and chronic	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN, DM	-	-	-
24	1058705	21-232	21-2805	MLG	73	M	25/3/2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
25	1060931	21-234	21-2874	H	60	M	27/3/2021	Backache	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	-	-	-	-
26	72551	21-236	21-2909	SS	60	M	28/3/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	H/C/O SCC tongue, HTN, DM, TB, Hypothyroidism	-	-	Pallor
27	1033593	21-238	21-2916	JK	65	F	29/3/2021	Weakness, loose stool	N	N	N	N	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	K/C/O CKD, HTN	-	-	-
28	1069548	21-240	21-2932	ML	65	M	30/3/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
29	1063131	21-242	21-2948	BS	69	M	31/3/2021	Lowerback pain, Loss of appetite	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	-	-	-	Pallor
30	1024177	21-247	21-3006	SK	62	M	04-01-2021	Weakness, Loss of appetite, backache, Loss of weight	N	N	N	N	N	N	Y	N	N	Y	N	N	Y	Y	N	N	N	N	-	-	-	Pallor
31	1065113	21-251	21-3050	NM	60	F	04-02-2021	Weakness, Loose stool	N	N	N	N	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	DM	-	-	-
32	1075014	21-256	21-3123	M	67	F	04-06-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN	-	-	Pallor
33	1073076	21-267	21-3213	GK	61	F	04-07-2021	Backache, Loss of weight, Loss of appetite	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	HTN. DM	-	-	-
34	1060408	21-261	21-3169	TS	81	M	04-06-2021	K/C/O CLL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN	-	-	Pallor
35	1073723	21-271	21-3236	MK	62	F	04-08-2021	Weakness, Loss of appetite, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	Y	N	N	N	N	HTN	-	-	Pallor
36	1084572	21-292	21-3493	DSS	77	M	16/4/2021	Weakness, Loss of weight, blood in stool	N	N	N	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N	N	Hemorrhoid grade 3	-	Alcoholic occasionaly	Pallor
37	1087788	21-297	21-3542	SD	61	F	17/4/2021	Pain lower back, Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N	-	-	-	-
38	459700	21-298	21-3548	SSS	83	M	17/4/2021	Breathlessness, nose bleeding, Weakness, bleeding of gums	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y	N	Y	HTN	-	-	Pallor

S. No.	P/A examination	Indication for bone marrow	HB	RBC	TLC	Neutrophils	Lymphocytes	Monocytes	Eosinophils	Basophils	Promyelocytes	Myelocytes/ Metamyelocytes	Plasma cells	Blasts/ Atypical cells	nRBC/100 WBC	Platelets	ESR	Corrected retic	Normocytes	Smudge cell	Roulex formation	Anisocytosis	Microcytes	Anisopiokilocytosis	Macroovalocytes	Macrocytes	Tear drop cells
0	-	Incidental findings- Increased Beta 2 microglobulin.	13	3.88	4.7	58	32	6	4	-	-	-	-	-	-	176	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
1	Splenomegaly	Pancytopenia	6.7	-	2.1	44	51	5	-	-	-	-	-	-	-	55	-	5%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
2	-	Pancytopenia	6.4	1.96	2	9	82	9	-	-	-	-	-	-	-	76	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
3	-	Pancytopenia	6.6	2.17	1.7	14	78	4	2	-	-	-	-	2	-	70	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
4	-	Bicytopenia	6.3	2.5	5	18	58	2	-	-	-	7	-	5	10	58	-	-	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
5	-	Pancytopenia	4.7	1.53	2.6	7.5	35.1	57.4	-	-	-	-	-	-	-	130	-	-	Present	Absent	Absent	Absent	Absent	Present	Present	Absent	Absent
6	-	Chronic lymphocytic leukemia	13.9	-	11.2	24	70	2	4	-	-	-	-	-	-	58	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
7	-	Thrombocytopenia	10.1	-	9.4	70	25	5	-	-	-	-	-	-	-	40	-	1.16%	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
8	-	Pancytopenia	7.6	-	1	58	30	10	2	-	-	-	-	-	-	60	118	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
9	-	? Tuberculosis ? Lymphoma ? MAS	10.4	-	17.1	80	18	2	-	-	-	-	-	-	-	150	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
10	-	Thrombocytopenia	11.7	4.88	7.5	49	44.7	6.3	-	-	-	-	-	-	-	150	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
11	-	Thrombocytopenia	10.5	-	8.3	65	30	2	3	-	-	-	-	-	-	150	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent
12	-	Absolute lymphocytosis	11.9	-	13.4	25	70	2	2	-	-	-	-	-	-	150	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
13	-	Multiple myeloma	7.8	3.3	14.5	85	10	5	-	-	-	-	-	-	-	180	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
14	-	Anemia	4	1.12	6	60	30	10	-	-	-	-	-	-	-	130	-	-	Absent	Absent	Absent	Absent	Absent	Present	Present	Present	Absent
15	-	Multiple myeloma	11.7	3.95	4.3	65	30	5	-	-	-	-	-	-	-	120	-	1%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
16	Hepatomegal, Spleenomegaly	-	7.8	-	15	65	22	-	-	-	-	8	-	5	5	120	-	-	Absent	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent
17	-	Leucocytosis	10.5	-	100	60	2	2	2	2	2	28	-	2	3	150	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
18	Splenomegaly	Multiple myeloma	10.5	-	2.9	68	30	20	-	-	-	-	-	-	-	69	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
19	-	? Lymphoma ? Aplastic anemia	7.3	3.02	1.3	64	30	6	-	-	-	-	-	-	-	72	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
20	-	Pancytopenia	7.3	-	0.5	4	4	2	-	-	-	-	-	-	-	140	-	0.05%	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
21	-	Multiple myeloma	6.3	-	11	77	20	2	1	-	-	-	-	-	-	256	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent
22	-	Anemia	5.9	-	6.1	60	38	2	-	-	-	-	-	-	-	150	-	< 0.05%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
23	-	Polycythemia	17.6	-	9.1	64	30	4	2	-	-	-	-	-	-	321	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
24	-	Fever	8.9	3.31	16.9	41	10	4	45	-	-	-	-	-	-	584	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
25	-	Multiple myeloma	12.2	-	6.6	68	26	4	2	-	-	-	-	-	-	254	-	0.80%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
26	-	Pancytopenia	5.7	-	0.6	2	5	3	-	-	-	-	-	-	-	68	-	-	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent
27	-	Multiple myeloma	6.8	-	17.4	81	14	5	-	-	-	-	-	-	-	78	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
28	-	Polycythemia	18.1	5.98	9.1	68	30	2	-	-	-	-	-	-	-	501	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
29	-	Plasma cells neoplasm	10.1	-	5	60	38	2	-	-	-	-	-	-	-	225	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
30	-	Renal amyloidosis	9.9	-	13.8	70	20	7	1	-	-	2	-	-	-	492	-	2%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
31	-	Iron deficency anemia	10.7	-	5.2	64	30	4	2	-	-	-	-	-	2	150	-	4%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
32	-	Multiple myeloma	8.9	-	11.2	60	32	6	2	-	-	-	-	-	-	267	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
33	Hepatomegaly	K/C/O Plasmacytoma	9.4	3.32	6.9	68	24	4	4	-	-	-	-	-	-	182	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
34	-	K/C/O CLL B cell type	10.5	-	64.7	8	82	2	-	-	-	-	-	-	-	217	-	1%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
35	-	Pancytopenia	7.3	-	1.4	75	20	4	1	-	-	-	-	-	-	89	-	2%	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
36	-	Leucocytosis	7.9	-	44	90	4	1	1	-	-	4	-	-	3	534	-	2%	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
37	-	Multiple myeloma	8.6	-	18.7	70	20	5	-	-	-	5	-	-	-	480	-	-	Present	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent
38	-	Multiple myeloma	7.6	-	9.7	75	15	2	8	-	-	-	-	-	-	186	-	-	Absent	Absent	Present	Present	Present	Absent	Absent	Absent	Absent

S. No.	Target cells	Pencil Cells	Normochromia	Hypochromia	Neutrophilia	Neutropenia	Eosinophilia	Monocytosis	Lymphocytosis	Leucocytosis	Leucopenia	Platelets	CT	PET	X-Ray	MRI	USG	Bone marrow aspiration_Site	Aspiration
0	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
1	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	Splenomegaly (14.1 cm)	Posterior superior iliac spine (right side)	Fragments present
2	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
3	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	Splenomegaly (14.1 cm)	Posterior superior iliac spine (right side)	Marrow diluted with blood
4	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
5	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	Renal parenchymal changes grade II, Mild ascitis	Posterior superior iliac spine (right side)	Fragments present
6	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
7	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
8	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	Bilateral renal parenchymal disease, right nephrolithiasis, right pyelitis	Posterior superior iliac spine (right side)	Marrow diluted with blood
9	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Present	Adequate	-	-	-	-	Chronic liver disease	Posterior superior iliac spine (right side)	Fragments present
10	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
11	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
12	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
13	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
14	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	Spleenomegaly	Posterior superior iliac spine (right side)	Fragments present
15	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	Hepatomegaly, Spleenomegaly	Posterior superior iliac spine (right side)	Marrow diluted with blood
16	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
17	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
18	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
19	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	Lymphadenopathy noted	-	-	-	Spleenomegaly	Posterior superior iliac spine (right side)	Marrow diluted with blood
20	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
21	Absent	Present	Absent	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
22	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	S/o stable disease status	-	-	-	Posterior superior iliac spine (right side)	Fragments present
23	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	Acute and chronic lacunar infacts right frontal lobe	-	Posterior superior iliac spine (right side)	Fragments present
24	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
25	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	? Primary bone tumor ? Ostisarcoma	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
26	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	Gallblader polyps, Spleenomegaly with multiple granulomas	Posterior superior iliac spine (right side)	Dry tap
27	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
28	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
29	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	Plasmacytoma, Lymphoma	-	Posterior superior iliac spine (right side)	Fragments present
30	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	Renal parenchymal changes grade III	Posterior superior iliac spine (right side)	Fragments present
31	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
32	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
33	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	S/o Metastatic disease	Left renal calculai, mild hepatomegaly, prostatomegaly	Posterior superior iliac spine (right side)	Fragments present
34	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
35	Absent	Present	Absent	Present	Present	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
36	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Dry tap
37	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	B/L acute renal disease	Posterior superior iliac spine (right side)	Marrow diluted with blood
38	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present

S. No.	Cellularity	Erythropoiesis	Leucopoiesis	Megakaryocytes	Blasts	Promyelocytes	Myelocytes	Metamyelocytes	Neutrophils	Eosinophils	Lymphocytes	Plasma cells	Erythroid cells	M:E Ratio	MPO	Iron	Bone marrow aspiration diagnosis	Bone marrow biopsy diagnosis
0	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	8	7	52	-	6	8	19	3.5:1	-	Reduced	Normocellular normoblastic marrow	Normocellular normoblastic marrow
1	Hypercellular marrow	Erythroid hyperplasia with normoblastic & megaloblastic maturation with features of dyserythropoiesis < 10 %	Orderly cell maturation	Adequate	-	-	8	6	17	1	2	-	66	1.0:2	-	Reduced	Dual deficiency anaemia	Dual deficiency anaemia
2	Hypercellular marrow	Normoblastic and megaloblastic maturation with features of dyserythropoiesis > 10 %	Myeloid precursor show dysplasia.	Present with dysplastic forms.	3	2	16	21	13	2	-	5	38	1.5:1	-	5+	MDS with multilineage dysplasia	MDS with multilineage dysplasia
3	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	Negative	-	ALL	ALL
4	Hypercellular marrow	Erythroid hyperplasia with normoblastic maturation, features of dyserythropoiesis seen in > 10 % erythroid precursors.	Depressed with feature of dysmyelopoiesis	Reduced with atypical forms	7	-	4	4	5	-	-	-	80	1.0:4	-	Reduced	MDS with multilineage dysplasia	MDS with multilineage dysplasia
5	Hypercellular marrow	Depressed with normoblastic maturation with megaloblastoid changes	Depressed with orderly cell maturation	Adequate	-	-	-	-	-	-	-	-	-	-	-	5+	MGUS	MGUS
6	Hypercellular marrow	Erythroid hyperplasia with normoblastic as well as megaloblastic maturation	Orderly cell maturation with prominence of eosinophils and eosimophilic precursor	Adequate	-	-	-	-	-	-	-	-	-	-	-	-	Marginal zone lymphoma	Marginal zone lymphoma
7	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Prominence with young forms	-	-	6	4	52	1	2	10	25	2.5:1	-	2+	Multiple myeloma	Multiple myeloma
8	Hypocellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	Aplastic anemia	Aplastic anemia
9	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	10	10	40	-	-	-	35	2.5:1	-	2+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
10	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	-	20	40	3	3	-	34	2.0:1	-	Reduced	Normocellular normoblastic marrow	Normocellular normoblastic marrow
11	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	10	15	39	1	2	-	33	2.0:1	-	2+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	No opinion	CLL
13	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	10	8	45	-	-	6	31	2.0:1	-	2+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
14	Hypercellular marrow	Erythroid hyperplasia with normoblastic & megaloblastic maturation with features of dyserythropoiesis < 10 %	Orderly cell maturation	Prominent	-	-	4	6	15	-	-	-	75	1.0:3	-	Reduced	Megaloblastic anemia	Megaloblastic anemia
15	Normocellular marrow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
16	Hypercellular marrow	Normoblastic & megaloblastic maturation with features of dyserythropoiesis > 10 %	Hyperplasia with dysmyelopoiesis > 10%	Depressed with atypical forms	5	-	26	27	32	-	-	-	10	8.0:1	-	Reduced	1, MDS 2, MDS/MPN	1, MDS 2, MDS/MPN
17	Hypercellular marrow	Depressed with normoblastic maturation	Myeloid with hyperplasia noted	-	4	-	25	18	40	2	-	-	11	1.1:1	-	Reduced	CML in chronic phase	CML in chronic phase
18	Hypercellular marrow	Erythroid prominence with normoblastic & megaloblastic maturation	Orderly cell maturation	Adequate	-	-	10	12	28	-	-	-	50	1.0:1	-	4+	Megaloblastic anemia	Megaloblastic anemia
19	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	CLL	CLL
20	Hypercellular marrow	Erythroid prominence with normoblastic maturation	Depressed with orderly cell maturation	Adequate	-	-	-	-	-	-	-	-	-	-	-	6+	HLH	HLH
21	-	Normoblastic maturation	Orderly cell maturation	-	-	-	10	10	30	-	-	-	50	01:01	-	3+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
22	Hypercellular marrow	Markedly supperssed	Orderly cell maturation	Adequate	-	-	-	-	-	-	-	-	-	-	-	6+	Red cell aplasia	Red cell aplasia
23	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Focally prominent	-	-	15	20	25	-	-	-	40	1.5:1	-	Reduced	Polycythemia vera	Polycythemia vera
24	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	6	4	19	45	-	7	19	4.0:1	-	6+	Hypereosinophilic syndrome	Hypereosinophilic syndrome
25	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	9	10	32	-	-	15	34	125.0:1	-	Reduced	Multiple myeloma	Multiple myeloma
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry tap	Hairy cell leukemia
27	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Present	-	-	-	-	-	-	-	-	-	-	-	4+	Multiple myeloma	Multiple myeloma
28	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Hyperplasia with clusterring exhibiting hypolobated and hyperlobated forms	-	-	15	10	42	-	-	-	33	2.0:1	-	Reduced	Polycythemia vera	Polycythemia vera
29	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
30	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	15	6	43	-	-	7	29	2.0:1	-	6+	Normocellular normoblastic marrow	Granulomatous inflammation
31	Hypercellular marrow	Erythroid hyperplasia with normoblastic maturation	Orderly cell maturation	Slight hyperplasia with many hyperlobated forms	-	-	8	10	15	-	-	-	67	1.0:2	-	4+	Megaloblastic anemia	Megaloblastic anemia
32	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	12	4	15	2	-	50	17	2.0:1	-	4+	Multiple myeloma	Multiple myeloma
33	Hypercellular marrow	Erythroid prominence with normoblastic maturation and megaloblastoid change	Orderly cell maturation	Normal in numbers and mophology	-	-	8	5	20	-	10	30	27	1.2:1	-	2+	Multiple myeloma	Multiple myeloma
34	Hypercellular marrow	Depressed	Depressed	Present	-	-	-	-	-	-	-	-	-	-	-	4+	CLL	CLL
35	Hypercellular marrow	Erythroid prominence with feature of dyserythropoiosis < 10%	Orderly cell maturation	Prominence with few monolobated forms	-	-	7	8	30	5	-	-	50	1.0:1	-	Reduced	MDS with multilineage dysplasia	MDS with multilineage dysplasia
36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Myelofibrosis	Myelofibrosis
37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
38	Mildly Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	9	13	36	-	10	4	28	2.0:1	-	-	Anemia of chronic disorder	Anemia of chronic disorder

S. No.	Other relevant investigation_Serum iron profile	Serum B12	Folate	Other infective etiology work up	Myeloma workup profile	Cytogenetic studies	Flowcytometry findings	IHC findings	Any other	Final diagnosis
0	-	-	-	-	-	-	-	-	-	Normocellular normoblastic marrow
1	32.5	1500	2.12	-	-	-	-	-	-	Dual deficiency anemia
2	-	> 1500	20	-	-	-	-	-	-	MDS
3	-	-	-	-	-	-	-	-	-	ALL
4	-	-	-	-	-	-	-	-	-	MDS
5	-	-	-	-	-	-	-	-	-	MGUS
6	-	-	-	-	-	-	-	Present	-	Marginal zone lymphoma
7	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
8	-	-	-	-	-	-	-	-	-	Aplastic anemia
9	-	-	-	-	-	-	-	-	LAP-131	Normocellular normoblastic marrow
10	-	-	-	-	-	-	-	-	-	Normocellular normoblastic marrow
11	-	-	-	-	-	-	-	-	-	Normocellular normoblastic marrow
12	-	-	-	-	-	-	Present	-	-	CLL
13	-	349	-	-	SPE- no M spike seen	-	-	-	-	Normocellular normoblastic marrow
14	-	-	-	-	-	-	-	-	-	Megaloblastic anemia
15	-	-	-	-	-	-	-	-	-	Multiple myeloma
16	-	-	-	-	-	-	-	-	-	MDS
17	-	-	-	-	-	-	-	-	-	CML in chronic phase
18	-	-	-	-	-	-	-	-	-	Megaloblastic anemia
19	-	-	-	-	-	-	-	-	-	CLL
20	-	-	-	-	-	-	-	-	-	HLH
21	-	-	-	-	IFE- M band in kappa region	-	-	-	Fish- Negative	Normocellular normoblastic marrow
22	-	-	-	-	-	-	-	-	-	Red cell aplasia
23	-	-	-	-	-	-	-	-	-	Polycythemia vera
24	-	-	-	-	-	-	-	-	-	Hypereosinophilic syndrome
25	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
26	72.4	955	20	-	-	-	-	-	-	Hairy cell leukemia
27	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
28	-	-	-	-	-	-	-	-	-	Polycythemia vera
29	-	-	-	-	-	-	-	-	Histo C/w plasmacytoma	Multiple myeloma
30	-	-	-	-	-	-	-	-	-	Granulomatous inflammation
31	406.3	-	-	-	-	-	-	-	Stool for occult blood- Positive	Megaloblastic anemia
32	-	34.02	-	-	IFE- IgG Lambda monoclonal gammopathy	-	-	-	-	Multiple myeloma
33	-	-	-	-	IFE- IgG Kappa monoclonal gammopathy, SPE- M spike seen	-	-	-	-	Multiple myeloma
34	-	-	-	-	-	-	CLL	-	-	CLL
35	27.7	-	-	-	-	-	-	-	-	MDS
36	-	-	-	-	-	-	-	-	BCR-ABL gene rearrengment, PCR quantitative- type of transcript - not detected	Myelofibrosis
37	-	-	-	-	-	-	-	-	-	Multiple myeloma
38	-	-	-	-	-	-	-	-	-	Anemia of chronic disorder

S. No.	MRD No.	Hematology No.	Surg. Path No.	Name	Age	Sex	Date	Chief presenting complaints	Petechiae	Burning micturition	Haemoptysis	SKIN MANIFESTATION	Loose stool	Melena	Weakness	Abdominal pain	Anemia	Backache	FEVER	Shortness of breath	Loss of weight	Loss of appetite	PAIN	BLEEDING	COUGH	OTHER	Past history	Family history	Personal history	General physical examination
39	186938	21-299	21-3567	B	69	M	21/4/2021	shortness of breath, cough, Weakness	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	Y	N	DM	-	-	Pallor
40	992166	21-300	21-3576	C	70	F	19/4/2021	Weakness, Loss of appetite	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	CKD, HTN, DM	-	-	Pallor
41	653877	21-303	21-3595	PK	71	F	23/4/2021	K/C/O right parietal meningioma (in 2014), loose motion	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
42	1089555	21-310	21-3738	KL	63	M	26/4/2021	Weakness, Malena, Loss of appetite	N	N	N	N	N	Y	Y	N	N	N	N	N	N	Y	N	N	N	N	Alcohlic	-	-	-
43	1080088	21-317	21-3772	AK	65	M	26/4/2021	Pain	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	DM	-	-	Pallor
44	985494	21-323	21-3826	AD	65	M	26/4/2021	pain shoulder, Unable to function with right hand	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	-	-	Alcoholic occasionaly	-
45	1106662	21-341	21-3924	CK	65	F	05-11-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	Intake of some medication for insomnia	-	-	-
46	1108435	21-344	21-3964	BS	84	M	14/5/2021	Weakness, Loss of appitite	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	-	-	-	Pallor
47	1107166	21-352	21-4044	S	65	F	19/5/2021	Weakness, cough	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	Y	N	-	-	-	Pallor
48	990296	21-353	21-4076	Gs	70	M	21/5/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	K/K/o myelopathy & infectious spondyloarthritis, DM	-	-	Pallor
49	1113199	21-367	21-4186	KK	63	F	27/5/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	Bony pain in knee	-	-	Pallor
50	1060293	21-368	21-4196	BL	65	M	28/5/2021	Fever, Weakness, bleeding nose on & off	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	Y	N	N	TB, K/c/o- CKD	-	Alcohol intake	-
51	1113430	21-372	21-4240	SD	61	F	29/5/2021	Bodyache, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	Y	-	-	-	-
52	1119288	21-380	-	VR	74	M	06-08-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Transfusion of blood-2PRBC/month	-	-	-
53	1118662	21-381	21-4473	BBG	70	M	06-07-2021	Backache	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
54	1120132	21-385	21-4533	JS	74	M	06-09-2021	Weakness, leg pain	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N	-	-	Alcoholic	-
55	1121816	21-400	21-4707	MD	70	F	14/6/2021	Weakness, bleeding from gums, Rashes on b/l legs	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	HTN, DM	-	-	-
56	1123204	21-407	21-4781	HS	73	M	16/6/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
57	1122717	21-408	21-4790	RKN	69	M	16/6/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
58	1122491	21-414	21-4860	JK	60	F	18/6/2021	Weakness, Lower limb pain	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N	HTN, DM	-	-	-
59	1123012	21-416	21-4868	GK	68	F	18/6/2021	Decreased urine output	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN, CAD, CKD, RA	-	-	-
60	1124675	21-419	21-4890	LD	60	M	19/6/2021	Weakness, Shortness of breath, chest pain	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	Y	N	N	N	-	-	-	-
61	1123035	21-422	21-4933	Sk	80	F	21/6/2021	Skin rashes & itching	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	-	-	-	Hepatospleno megaly
62	1125435	21-423	21-4931	BS	72	M	21/6/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	Alcoholic, Tobacco intake	Pallor
63	1126006	21-426	21-4975	RK	62	F	22/6/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
64	1128519	21-442	21-5197	BS	73	M	28/6/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
65	1129199	21-446	21-5242	R	60	F	29/6/2021	Weakness, Fever, Nasal bleed	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	Y	N	N	HTN	-	-	Pallor
66	1128921	21-453	21-5389	HK	63	F	07-02-2021	H/o fall/ fracture right shoulder & right hip, Backache	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Y	K/C/o multiple myeloma	-	-	-
67	1130539	21-455	21-5448	BS	64	M	07-03-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
68	1131238	21-456	21-5446	M	62	M	07-03-2021	Weakness, Blackish discoloration of B/L lower limbs, Weight Loss	N	N	N	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	-	Mother had breast carcinoma	-	-
69	1129660	21-459	21-5478	PK	64	M	07-05-2021	Weakness, Backache	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
70	1132149	21-466	21-5626	LD	72	F	07-08-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-

S. No.	P/A examination	Indication for bone marrow	HB	RBC	TLC	Neutrophils	Lymphocytes	Monocytes	Eosinophils	Basophils	Promyelocytes	Myelocytes/ Metamyelocytes	Plasma cells	Blasts/ Atypical cells	nRBC/100 WBC	Platelets	ESR	Corrected retic	Normocytes	Smudge cell	Roulex formation	Anisocytosis	Microcytes	Anisopiokilocytosis	Macroovalocytes	Macrocytes	Tear drop cells
39	-	Chronic lymphocytic leukemia	9	-	128.4	6	92	2	-	-	-	-	-	-	-	433	-	-	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
40	-	Multiple myeloma	9.7	-	9.8	70	18	10	2	-	-	-	-	-	-	206	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
41	-	Thrombocytosis	10.6	-	7.9	62	34	2	2	-	-	-	-	-	-	789	-	1.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
42	-	-	7.5	-	51.7	72	5	18	-	-	-	5	-	-	-	26	-	-	Absent	Absent	Absent	Absent	Present	Present	Absent	Absent	Present
43	-	Macrophage activation syndrom	8	-	2.2	38	52	10	-	-	-	-	-	-	2	178	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
44	-	Multiple myeloma	11.3	-	8.3	35	60	4	1	-	-	-	-	-	-	190	-	1.20%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
45	-	MDS	9.7	-	1.7	7	89	3	1	-	-	-	-	-	-	232	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
46	-	Multiple myeloma	11.2	-	9.6	82	14	4	-	-	-	-	-	-	-	530	-	0.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
47	Splenomegaly	Bicytopenia under evaluation	9.3	-	9.7	92	6	2	-	-	-	-	-	-	-	92	-	4.20%	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
48	-	Bicytopenia	4.5	-	39.3	5	10	8	-	-	5	30	-	40	-	98	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Absent	Present
49	-	Multiple myeloma	5.8	-	8.4	55	40	3	2	-	-	-	-	-	-	316	-	0.50%	Present	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent
50	Splenomegaly	Pancytopenia	6.5	-	4.3	60	30	8	2	-	-	-	-	-	-	110	-	0.50%	Present	Absent	Absent	Present	Present	Absent	Absent	Present	Absent
51	-	Multiple myeloma	7.7	-	4.4	67	25	3	2	-	-	3	-	-	-	150	-	-	Absent	Absent	Absent	Absent	Present	Present	Absent	Absent	Present
52	-	Transfusion dependent anemia	9.8	-	5.9	54	30	10	6	-	-	-	-	-	-	185	-	1.16%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
53	Hepatomegaly	Multiple myeloma	9.8	-	8.1	58	32	10	-	-	-	-	-	-	-	568	-	1.50%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
54	-	MPN (CMML)	7.9	-	16.8	36	31	28	1	-	-	4	-	-	-	158	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Present	Absent
55	-	Thrombocytopenia	11.7	-	8.5	85	10	3	2	-	-	-	-	-	-	20	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
56	-	CLL	11.6	-	108.8	15	80	5	-	-	-	-	-	-	-	132	-	0.50%	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
57	-	Pancytopenia	6.1	-	1.9	50	38	10	2	-	-	-	-	-	-	20	-	-	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
58	-	Leucocytosis under evaluation	12.3	-	23.2	77	15	3	2	-	-	3	-	-	-	448	-	-	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
59	Hepatomegaly	Multiple myeloma	8.8	-	10.4	60	20	12	3	-	-	-	5	-	-	200	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
60	-	Leucocytosis with anemia & thrombocytosis	9.6	-	20	40	20	5	3	-	-	30	-	2	8	600	-	1.50%	Absent	Absent	Absent	Absent	Present	Present	Absent	Present	Present
61	-	CLL	6.8	-	416	6	92	1	1	-	-	-	-	-	-	160	-	-	Present	Present	Absent	Absent	Absent	Present	Present	Present	Absent
62	-	Pancytopenia	6.3	-	1.7	38	60	2	-	-	-	-	-	-	-	60	-	-	Present	Absent	Absent	Present	Absent	Absent	Present	Present	Absent
63	-	MPN	15	-	10	70	20	5	5	-	-	-	-	-	-	733	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
64	-	K/c/o- MPN	7.1	-	19.6	71	7	2	20	-	-	-	-	-	-	1219	-	-	Absent	Absent	Absent	Absent	Present	Present	Absent	Absent	Present
65	-	Pancytopenia ? Low grade lymphoma ? HCL ? SMZL ?P HSTL	11.3	-	2.3	50	48	2	-	-	-	-	-	-	-	90	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
66	Hepatomegaly	K/c/o Multiple myeloma	9.7	-	8.1	70	20	7	3	-	-	-	-	-	-	304	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
67	-	Acute Leukemia	7.7	-	3.6	25	51	5	5	-	-	-	-	14	4	44	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
68	-	Multiple myeloma	13.3	-	5.7	55	35	10	-	-	-	-	-	-	-	166	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
69	-	Multiple myeloma	7.3	-	6.4	47	45	7	1	-	-	-	-	-	-	237	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
70	-	CLPD ?CLL	11.1	-	25.6	26	72	2	-	-	-	-	-	-	-	448	-	1.40%	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent

S. No.	Target cells	Pencil Cells	Normochromia	Hypochromia	Neutrophilia	Neutropenia	Eosinophilia	Monocytosis	Lymphocytosis	Leucocytosis	Leucopenia	Platelets	CT	PET	X-Ray	MRI	USG	Bone marrow aspiration_Site	Aspiration
39	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
40	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
41	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	-	-	-	Fatty liver	Posterior superior iliac spine (right side)	Fragments present
42	Present	Present	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	B/l renal parenchymal changes grade 2 with ascites with B/L splenomegaly	Posterior superior iliac spine (right side)	Fragments present
43	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Adequate	-	-	-	-	Mild B/L PCS fullness with feature of b/l pyelitis	Posterior superior iliac spine (right side)	Fragments present
44	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
45	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Scanty fragments
46	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	-	-	S/o Benign central wedging/compression fracture of L1 vertebra	-	Posterior superior iliac spine (right side)	Fragments present
47	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	Cholelithiasis, mild splenomegaly, uterus fibroid	Posterior superior iliac spine (right side)	Fragments present
48	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
49	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	S/o Hyperostosis frontalis interna	-	-	Posterior superior iliac spine (right side)	Fragments present
50	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
51	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	1, FDG avid lesion axial & appendicular skeleton- possibly malignant. 2, FDG avid pelvic lymph nodes- metastatic.	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
52	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
53	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	D/o Multiple myeloma	-	-	-	Posterior superior iliac spine (right side)	Fragments present
54	Absent	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
55	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
56	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
57	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
58	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
59	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
60	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
61	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
62	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
63	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
64	Absent	Present	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
65	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
66	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	Metabolic acute disease showing lytic/sclerotic skeletal lesion (Multiple collapse vertebrae) & soft tissue component	-	-	-	Posterior superior iliac spine (right side)	Fragments present
67	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
68	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
69	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	Metabolic acute disease involving lytic skeletal lesion	-	-	-	Posterior superior iliac spine (right side)	Fragments present
70	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present

S. No.	Cellularity	Erythropoiesis	Leucopoiesis	Megakaryocytes	Blasts	Promyelocytes	Myelocytes	Metamyelocytes	Neutrophils	Eosinophils	Lymphocytes	Plasma cells	Erythroid cells	M:E Ratio	MPO	Iron	Bone marrow aspiration diagnosis	Bone marrow biopsy diagnosis
39	Hypercellular marrow	Depressed	Depressed	Present	-	-	-	-	-	-	-	-	-	-	-	-	CLL	CLL
40	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	15	18	32	4	-	3	28	2.5:1	-	6+	Anemia of chronic disorder	Anemia of chronic disorder
41	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Mild prominence	-	-	12	18	28	6	4	4	28	2.5:1	-	4+	ET	ET
42	Hypercellular marrow	Normoblastic maturation with megaloblastoid change & f/o dyserythropoiesis	Myeloid precursor show f/o dysmyelopoiesis > 10% seen as hyposegmented, hypersegmented & hypogranular forms. Few scattered monocytes also seen. No significant prominence of blast cells seen.	Slightly prominent having atypical features seen as hypolobated & hyperlobated forms. Multi nucleated megakaryocytes seen.	2	-	20	19	31	-	-	-	28	2.5:1	-	4+	MDS/MPN	MDS/MPN
43	Cellular marrow	Prominence with normoblastic maturation with f/o dyserythropoiesis >10%	Orderly cell maturation	Prominent	-	-	15	10	20	-	-	15	40	1.2:1	-	6+	HLH	HLH
44	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	4	6	10	-	-	60	20	1.0:1	-	-	Multiple myeloma	Multiple myeloma
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Positive	-	APML	APML
46	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	10	4	40	4	-	6	36	1.6:1	-	5+	MGUS	MGUS
47	Hypercellular marrow	Depressed with normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	-	-	11	-	78	2	9	-	-	Reduced	Lymphoprolifirative neoplasm	Lymphoplasmacytic lymphoma
48	Hypercellular marrow	Depressed with dysplasia	Myeloid hyperplasia	Prsent with dysplasia	-	-	-	-	-	-	-	-	-	Positive in blasts cells	-	Reduced	Acute leukemia	AML with monocytic differentiation
49	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	8	12	13	-	10	30	27	1.2:1	-	4+	Plasma cell dyscrasia	Multiple myeloma
50	Normocellular marrow	Erythroid prominence with normoblastic maturation and micronormoblastic maturation	Orderly cell maturation	Prominent with few young forms	-	-	6	10	20	-	15	2	47	1.0:1.3	-	6+	Anemia of chronic disorder	Anemia of chronic disorder
51	Hypercellular marrow	Depressed	Depressed	-	-	-	8	12	13	-	10	30	27	1.2:1	-	4+	Non Hodgkin lymphoma	Non Hodgkin lymphoma
52	Hypercellular marrow	Normoblastic maturation with f/o dyserythropoiesis <10%	Orderly cell maturation	Prominence with dysmegakaryopoiesis	-	-	12	19	34	4	4	4	23	3.0:1	-	6+	Anemia of chronic disorder	Anemia of chronic disorder
53	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	-	-	-	-	-	-	-	-	-	-	-	-	5+	Multiple myeloma	Multiple myeloma
54	Hypercellular marrow	Relatively depressed with normoblastic maturation & f/o dyserythropoiesis upto 6%	Myeloid hyperplasia with prominence of monocytes & monocytoid precursors constituting 15% of all nucleated cells. Prominence of blasts constituting 8% of all nucleated cells. Few hyper granular myeloid precursor also seen.	Adequate. Dysplastic megakaryocytes seen as hypolobated forms	8	15	10	20	31	1	-	3	12	6.4:1	-	3+	dry tap	CMML
55	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Prominence with few young forms	-	-	4	29	30	2	-	1	34	2.0:1	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
56	Hypercellular marrow	Depressed	Depressed	Occasional	-	-	-	-	-	-	-	-	-	-	-	-	CLL	CLL
57	-	-	-	Occasional	-	-	-	-	-	-	-	-	-	-	-	6+	HLH	HLH
58	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Prominence with normal morphology	-	-	20	24	28	6	-	-	20	4.0:1	-	Reduced	CML in chronic phase	CML in chronic phase
59	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Normal	-	-	-	-	-	-	-	-	-	-	-	-	Multiple Myeloma	Multiple Myeloma
60	Hypercellular marrow	Normoblastic maturation & f/o dyserythropoiesis < 10% noted	Orderly cell maturation	Hyperplasia with hypolobated and hyperlobated forms	1	-	20	7	35	2	-	-	35	1.8:1	-	5+	CML in chronic phase	CML in chronic phase
61	Hypercellular marrow	Depressed	Depressed with orderly cell maturation	Occasional	-	-	-	-	-	-	-	-	-	-	-	-	CLL	CLL
62	Hypercellular marrow	Depressed with f/o dyserythropoiesis >10%	Depressed with orderly cell maturation	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	Acute leukemia	AML
63	Cellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent with variably sized hypolobular forms	-	-	12	9	30	4	4	3	38	1.4:1	-	Reduced	ET	ET
64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ET	ET
65	Normocellular marrow	Normoblastic maturation & f/o dyserythropoiesis < 10% noted	Orderly cell maturation	Prominent	-	-	4	30	20	-	8	3	35	1.5:1	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
66	Patchily cellular marrow with increased fat space in few fragments	Erythroid prominence with normoblastic maturation	Orderly cell maturation	Normal	-	-	14	7	20	-	6	4	49	1.0:1	-	5+	Multiple myeloma	Multiple myeloma
67	Hypercellular marrow	Depressed with normoblastic as well as megaloblastic maturation with f/o dyserythropoiesis > 10%	Depressed	Present f/o dysmegakaryopoiesis < 10%	-	-	-	-	-	-	-	-	-	-	-	-	Acute leukemia	AML
68	Normocellular marrow	Normoblastic as well as megaloblastic maturation	Orderly cell maturation	Normal	-	-	10	6	16	2	-	9	54	1.0:1.5	-	4+	MGUS	MGUS
69	Hypercellular marrow	Depressed	Depressed	Present	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
70	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	10	17	20	-	30	5	18	2.6:1	-	Reduced	CLL	CLL

S. No.	Other relevant investigation_Serum iron profile	Serum B12	Folate	Other infective etiology work up	Myeloma workup profile	Cytogenetic studies	Flowcytometry findings	IHC findings	Any other	Final diagnosis
39	-	-	-	-	-	-	CLL	-	-	CLL
40	-	-	-	-	-	-	-	-	-	Anemia of chronic disorder
41	-	-	-	-	-	-	-	-	-	ET
42	-	-	-	-	-	-	-	-	-	MDS
43	-	-	-	-	-	-	-	-	-	HLH
44	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
45	-	-	-	-	-	PML-RARA t (15,17)- Detected	Present	-	-	APML
46	-	-	-	-	SPE- M spike seen	-	-	-	-	MGUS
47	-	-	-	-	SPE- M spike seen, IFE - IgM lambda monoclonal gammopathy	-	-	-	-	Lymphoplasmacytic lymphoma
48	-	-	-	-	-	-	AML with monocytic differentiation	-	-	AML with monocytic differentiation
49	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
50	-	-	-	-	-	-	-	-	-	Anemia of chronic disorder
51	-	-	-	-	-	-	-	Diffuse large B- cell lymphoma, stage 4	-	Diffuse large B- cell lymphoma, stage 4
52	-	>2000pg/ml	>24ng/ml	-	-	-	-	-	-	Anemia of chronic disorder
53	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
54	-	-	-	-	-	-	-	-	CML in chronic phase	CMML
55	-	-	-	-	-	-	-	-	ANA profile- Negative	Hyperdestructive thrombocytopenia
56	-	-	-	-	-	-	CLL	-	-	CLL
57	-	-	-	-	-	-	-	-	-	HLH
58	-	-	-	-	-	JAK-2 mutation	-	-	ANA IF- Positive	CML in chronic phase
59	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
60	-	-	-	-	-	-	-	-	-	CML in chronic phase
61	-	-	-	-	-	-	CLL	-	-	CLL
62	-	-	-	-	-	-	AML	-	-	AML
63	-	-	-	-	-	JAK2-V617F- Mutant wild type- Positive	-	-	-	ET
64	-	459 pg/ml	-	-	-	CALR mutation- Not detected, JAK2V617F mutation- Negative, RTPCR for BCR-ABC- Negative	-	-	-	ET
65	-	>500 pg/ml	16.6 ng/ml	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
66	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
67	-	-	-	-	-	-	AML	-	-	AML
68	-	>2000 pg/ml	>40 ng/ml	-	IFE- IgA Kappa monoclonal gammopathy	-	-	-	-	MGUS
69	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
70	-	-	-	-	-	-	CLL	-	-	CLL

S. No.	MRD No.	Hematology No.	Surg. Path No.	Name	Age	Sex	Date	Chief presenting complaints	Petechiae	Burning micturition	Haemoptysis	SKIN MANIFESTATION	Loose stool	Melena	Weakness	Abdominal pain	Anemia	Backache	FEVER	Shortness of breath	Loss of weight	Loss of appetite	PAIN	BLEEDING	COUGH	OTHER	Past history	Family history	Personal history	General physical examination
71	1127648	21-468	21-5648	HR	72	M	07-08-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
72	1116001	21-469	21-5660	P	78	M	07-08-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
73	1031945	21-471	21-5674	V	64	M	07-09-2021	Weakness, drowsiness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	HTN, DM	-	-	-
74	1131790	21-472	21-5676	DS	60	M	07-09-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
75	1133901	21-474	21-5698	HK	65	F	07-09-2021	Weakness, Backache	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	HTN	-	-	Pallor
76	1134722	21-475	21-5723	DJ	82	M	07-10-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
77	1133049	21-476	21-5741	DK	81	M	07-10-2021	Weakness, Melena	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	Pallor
78	1135109	21-481	21-5796	J	70	M	07-12-2021	Backache	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	HTN	-	-	-
79	1131079	21-485	21-5849	AS	76	M	13/7/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
80	38270	21-493	21-5995	CK	63	F	16/7/2021	Fever, Dry cough	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	DM, K/c/o Wegener's granulomatosis, (Covid 1 month backK)	-	-	-
81	1136710	21-494	21-6020	RS	66	M	16/7/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
82	1006939	21-498	21-6041	PK	85	F	17/7/2021	Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	Hypothyroidsim	-	-	-
83	1138914	21-503	21-6074	KR	69	M	17/7/2021	Leg Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	DM	-	-	Pallor
84	1139124	21-505	21-6081	PS	75	M	19/7/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
85	1139245	21-512	21-6171	HB	72	M	21/7/2021	case of Balanoposthitis, planned for circumcision, Thrombocytopenia detected	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	DM	-	-	-
86	1140289	21-514	21-6173	KD	70	F	21/7/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
87	1137181	21-515	21-6183	RC	62	M	21/7/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
88	1136823	21-520	21-6260	TS	85	M	23/7/2021	Knee Pain	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	HTN	-	-	Pallor
89	1140730	21-521	21-6270	KD	80	F	23/7/2021	Weakness, petechiae in legs	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
90	1139420	21-522	21-6280	A	62	M	23/7/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
91	1142128	21-537	21-6504	HL	75	M	29/7/2021	Weakness, Backache	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	-	-	-	-
92	1146702	21-541	21-6627	SC	72	M	08-02-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	Pallor, Purpura Petechiae
93	1146579	21-542	21-6631	JR	63	M	08-02-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	Pallor
94	1144765	21-547	21-6712	G	71	M	08-03-2021	Weakness, Backache	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
95	1146411	21-550	21-6744	SL	65	M	08-04-2021	Right leg pain, Black stool, Backache	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Fall in washroom, Liver cirrhosis	-	Alcoholic	Pallor
96	1147957	21-552	21-6775	SL	60	F	08-04-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	Pallor
97	1147926	21-554	21-6789	SK	60	F	08-05-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN	-	-	Palor
98	1147153	21-556	21-6802	BD	67	F	08-05-2021	Weakness, Abdominal Pain	N	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	DM	-	-	Pallor
99	678655	21-557	21-6837	MK	74	F	08-06-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, Liver cirrhosis	-	-	Pallor
100	326415	21-561	21-6867	PS	66	M	08-06-2021	Weakness, Abdominal pain	N	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	K/c/o Psoriasis	-	Alcoholic	-
101	1150035	21-562	21-6898	G	90	M	08-07-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
102	1150446	21-566	21-6929	KD	60	F	08-09-2021	Weakness, Fever, Hemoptysis	N	N	Y	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN, Melena, DM	-	-	Pallor
103	1152038	21-573	21-7121	SL	72	M	08-12-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	Pallor
104	1154681	21-582	21-7238	DRC	67	M	16/8/2021	Fever, generalized Weakness	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	DM	-	-	-
105	1153196	21-586	21-7253	BK	70	F	16/8/2021	generalized Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
106	1155209	21-587	21-7298	DL	62	M	16/8/2021	Pain lower back & leg	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	HTN, DM, TB on ATT	-	-	-
107	1155564	21-590	21-7302	AS	77	M	17/8/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	K/c/o carcinoma prostate	-	-	Pallor

S. No.	P/A examination	Indication for bone marrow	HB	RBC	TLC	Neutrophils	Lymphocytes	Monocytes	Eosinophils	Basophils	Promyelocytes	Myelocytes/ Metamyelocytes	Plasma cells	Blasts/ Atypical cells	nRBC/100 WBC	Platelets	ESR	Corrected retic	Normocytes	Smudge cell	Roulex formation	Anisocytosis	Microcytes	Anisopiokilocytosis	Macroovalocytes	Macrocytes	Tear drop cells
71	Hepatomegaly	Pancytopenia ?MAS	7.4	-	3.3	75	20	3	2	-	-	-	-	-	-	46	-	-	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
72	-	Bicytopenia	6.5	-	4.5	30	55	10	2	-	-	-	-	3	-	500	-	-	Absent	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent
73	-	K/c/o Multiple myeloma	7.8	-	6.2	50	26	-	-	-	-	4	20	-	-	70	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
74	Splenomegaly	Transfusion dependent anemia	7.9	-	4.8	78	22	4	2	-	-	-	-	-	-	221	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
75	-	Multiple myeloma	12	-	8.9	50	45	5	-	-	-	-	-	-	-	319	-	0.60%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
76	-	Multiple myeloma	10	-	5	57	35	7	1	-	-	-	-	-	-	198	105	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
77	Splenomegaly	Anemia under evaluation	7.7	-	6.3	73	20	5	2	-	-	-	-	-	-	120	-	5%	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
78	-	-	6.1	-	7	48	36	10	4	-	-	-	2	-	-	190	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
79	-	Bicytopenia	7.3	-	12.1	80	8	8	4	-	-	-	-	-	-	100	-	0.60%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
80	-	Bicytopenia	10.9	-	1.7	10	85	4	1	-	-	-	-	-	-	246	-	6.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
81	Hepatosplenomegaly	Acute Leukemia	7.8	-	5.4	8	43	7	2	-	-	-	-	40	-	52	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
82	-	Hypercalcemia ? Malignancy ? Plasma cell dyscrasia	12.4	-	8.2	59	27	11	3	-	-	-	-	-	-	254	-	0.60%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
83	-	Thrombocytopenia	14.9	-	12.7	92	5	2	1	-	-	-	-	-	-	4	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
84	-	Plasma cell dyscrasia	12	-	8.6	54	35	8	3	-	-	-	-	-	-	247	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
85	-	Thrombocytopenia	11.6	-	11.1	52	39	7	2	-	-	-	-	-	-	54	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
86	Hepatosplenomegaly	Anemia under evaluation ? MDS	7	-	6.5	41	50	8	1	-	-	-	-	-	-	331	-	1%	Absent	Absent	Absent	Absent	Present	Present	Present	Present	Absent
87	-	Peripheral eosinophilis ? Clonal ? Reactive	11.1	-	17.1	43	23	2	32	-	-	-	-	-	-	381	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
88	-	Plasma cell dyscrasia	11.1	-	7.2	70	22	6	2	-	-	-	-	-	-	235	-	0.70%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
89	-	Thrombocytopenia	12.3	-	12.7	80	15	4	1	-	-	-	-	-	-	46	-	0.80%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
90	-	Multiple myeloma	12.3	-	11.7	80	12	6	2	-	-	-	-	-	-	198	-	0.70%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
91	-	Multiple myeloma	8	-	42	89	3	2	2	-	-	4	-	-	-	50	-	0.40%	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
92	Hepatomegaly	Pancytopenia	9.8	-	3.2	70	24	4	2	-	-	-	-	-	-	110	-	0.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
93	-	Thrombocytopenia	9.6	-	7.5	60	28	8	4	-	-	-	-	-	-	70	-	0.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
94	-	Multiple myeloma	10.9	-	7.5	60	30	7	3	-	-	-	-	-	-	309	-	0.30%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
95	Splenomegaly	Anemia	9.3	-	6.4	70	22	6	2	-	-	-	-	-	-	150	-	2.80%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
96	Hepatomegaly	Myeloma	7.1	-	10.8	72	20	6	2	-	-	-	-	-	-	312	-	0.50%	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent
97	-	CLL	9.1	-	14.9	20	75	4	1	-	-	-	-	-	-	64	-	0.70%	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
98	Splenomegaly	Pancytopenia/Aplastic anemia	9.4	-	1.7	60	30	7	3	-	-	-	-	-	-	90	-	1%	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
99	-	Pancytopenia	5.3	-	3.5	55	35	7	3	-	-	-	-	-	-	90	-	1%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
100	-	Pancytopenia	7.1	-	0.5	3	1	1	-	-	-	-	-	-	-	38	-	0.10%	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
101	Splenomegaly	-	5.3	-	2.8	55	35	7	3	-	-	-	-	-	-	37	-	0.30%	Absent	Absent	Absent	Present	Present	Absent	Absent	Present	Absent
102	-	? ITP ? Malignancy	5.7	-	5.1	31	48	4	1	-	-	2	-	14	6	42	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
103	Hepatomegaly, Splenomegaly	Pancytopenia with agglutination	6.8	-	5.5	65	20	12	3	-	-	-	-	-	-	64	-	0.80%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
104	Hepatomegaly, Splenomegaly	-	7.4	-	0.6	14	10	1	-	-	-	-	-	-	-	46	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
105	-	Metastasis/ Lymphoma	8.2	-	8.7	40	20	10	1	-	-	3	-	26	5	100	-	1.40%	Present	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent
106	-	Multiple myeloma	11.1	-	9.4	78	16	4	2	-	-	-	-	-	-	235	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
107	-	Metastasis	8.7	-	13	70	18	4	2	-	-	6	-	-	3	42	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

S. No.	Target cells	Pencil Cells	Normochromia	Hypochromia	Neutrophilia	Neutropenia	Eosinophilia	Monocytosis	Lymphocytosis	Leucocytosis	Leucopenia	Platelets	CT	PET	X-Ray	MRI	USG	Bone marrow aspiration_Site	Aspiration
71	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	Mild Hepatomegaly	Posterior superior iliac spine (right side)	Fragments present
72	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Dry tap
73	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
74	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	Splenomegaly	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
75	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	Skull- Multiple cystic lesion	Spine- S/o Multilevel disc bulge	-	Posterior superior iliac spine (right side)	Fragments present
76	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
77	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
78	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	Skull- Lytic bone lesion	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
79	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
80	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
81	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right & left side)	Marrow diluted with blood
82	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
83	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	P/o Hepatic metastatis / Lymphoma	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
84	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
85	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
86	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
87	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
88	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
89	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
90	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
91	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
92	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
93	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
94	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
95	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
96	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Mild	Absent	Adequate	-	-	Skull- Visualized bones appear grossly normal	-	-	Posterior superior iliac spine (right side)	Fragments present
97	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
98	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
99	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Mild	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
100	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
101	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
102	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right & left side)	Marrow diluted with blood
103	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
104	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (left side)	Dry tap
105	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
106	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	Spine- Multifocal nodular lesion in B/L iliac bones & sacrum	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
107	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present

S. No.	Cellularity	Erythropoiesis	Leucopoiesis	Megakaryocytes	Blasts	Promyelocytes	Myelocytes	Metamyelocytes	Neutrophils	Eosinophils	Lymphocytes	Plasma cells	Erythroid cells	M:E Ratio	MPO	Iron	Bone marrow aspiration diagnosis	Bone marrow biopsy diagnosis
71	Normocellular marrow	Normoblastic maturation	Maturation arrest with P/o myelocytes & metamyelocytes	Adequate	-	-	38	26	6	1	5	5	19	3.5:1	-	4+	HLH	HLH
72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry tap	Myelofibrosis
73	Hypercellular marrow	Depressed	Depressed	Sheets of plasma cells noted constituting 95% of all nucleated cells with p/o many plasmablasts	-	-	-	-	-	-	-	-	-	-	-	-	Plasma cell leukemia	Plasma cell leukemia
74	Hypercellular marrow	Erythroid hyperplasia with normoblastic maturation & megaloblastoid change & F/o dyserythropoiesis < 10%	Orderly cell maturation with dysmyelopoiesis <10%	Normal	-	-	8	6	16	3	-	3	64	1.0:2	-	6+	Megaloblastic anemia	Megaloblastic anemia
75	Hypercellular marrow	Depressed	Depressed	Normal	-	-	-	-	-	-	-	-	-	-	-	Reduced	Multiple myeloma	Multiple myeloma
76	Hypercellular marrow	Depressed with Normoblastic maturation	Depressed with orderly cell maturation	Normal	-	-	6	9	11	-	-	48	26	1.0:1	-	Reduced	Multiple myeloma	Multiple myeloma
77	Hypercellular marrow	Erythroid hyperplasia with normoblastic maturation & megaloblastoid maturation	Depressed with orderly cell maturation	Normal	-	-	7	6	8	2	-	1	64	1.0:2.7	-	Absent	Hemolytic anemia	Hemolytic anemia
78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
79	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	29	17	30	2	4	-	18	4.3:1	-	5+	HLH	HLH
80	Hypercellular marrow with prominence of fat space	Depressed with Normoblastic maturation	Depressed	Present	-	-	-	-	-	-	-	-	-	-	-	Reduced	Hypocellular marrow	Hypocellular marrow
81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ALL	ALL
82	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	16	10	34	3	3	4	30	-	-	-	Normocellular normoblastic marrow	Normocellular normoblastic marrow
83	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Slightly prominence	-	-	19	10	44	1	-	-	26	2.8:1	-	2+	Malignancy	Malignancy
84	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Normal	-	-	16	11	32	3	-	8	30	2.0:1	-	Absent	Normocellular normoblastic marrow	Normocellular normoblastic marrow
85	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	20	12	38	3	-	-	27	2.7:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MDS	MDS
87	Mildly Hypercellular marrow	Normoblastic maturation	Eosinophilic precursors constituting 21% of all nucleated cells	Prominent	-	2	18	10	28	21	-	-	20	4.0:1	-	4+	Leukemoid reaction	Leukemoid reaction
88	Cellular marrow	Erythroid prominence with Normoblastic maturation	Orderly cell maturation	Normal	-	-	23	5	29	-	-	7	36	-	-	-	MGUS	MGUS
89	Cellular marrow	Normoblastic maturation	Myeloid prominence with orderly cell maturation & prominence of granules	Normal in numbers and mophology	-	-	30	14	30	5	-	3	18	4.3:1	-	3+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
90	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	22	13	38	-	-	4	23	2.7:1	-	4+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
91	Cellular marrow	Normoblastic maturation	Myeloid prominence with orderly cell maturation & Toxic granulation noted	Prominent with hyperlobated atypical forms	-	-	30	18	26	3	-	3	20	3.8:1	-	5+	Leukemoid reaction	Leukemoid reaction
92	Normocellular marrow	Normoblastic maturation with megaloblastoid change	Orderly cell maturation	Prominent	-	-	22	16	30	-	-	4	28	2.5:1	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
93	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent	-	-	20	12	37	4	3	-	24	3.0:1	-	4+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
94	Cellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	20	14	30	-	-	6	30	2.0:1	-	3+	Multiple myeloma	Multiple myeloma
95	Normocellular marrow	Prominence with normoblastic & megaloblastic maturation.	Orderly cell maturation	Normal	-	-	8	12	20	4	2	7	47	1.0:1	-	5+	Anemia of chronic disorder	Anemia of chronic disorder
96	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	20	10	29	4	4	8	25	2.5:1	-	5+	Anemia of chronic disorder	Anemia of chronic disorder
97	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Normal in numbers and mophology	-	-	-	-	-	-	-	-	-	-	-	3+	CLL	CLL
98	Hypercellular marrow	Hyperplasia with Normoblastic maturation with f/o dyserythropoiesis < 10%	Depressed with orderly cell maturation	Present	-	-	10	6	17	-	-	-	67	1.0:2	-	5+	Megaloblastic anemia	Megaloblastic anemia
99	Hypercellular marrow	Normoblastic maturation with megaloblastoid changes with f/o dyserythropoiesis > 10% seen as binucleated and nuclear budding	Orderly cell maturation	Normal in numbers and mophology	-	-	20	12	22	-	-	6	40	1.0:2	-	Reduced	Megaloblastic anemia	Megaloblastic anemia
100	Hypocellular marrow	Depressed	Depressed with matoration arrest upto metamyelocyte stage	Depressed	-	-	15	10	5	-	15	15	40	1.2:1	-	6+	HLH	HLH
101	Hypercellular marrow	Erythroid prominence having Normoblastic maturation with megaloblastoid change with f/o dyserythropoiesis > 10%	Orderly cell maturation	Present with f/o dysmegakaryopoiesis seen as monolobated, hypolobated & hyper lobated forms >10%	-	-	9	7	14	-	-	5	65	1.0:2	-	6+	MDS with multilineage dysplasia	MDS with multilineage dysplasia
102	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	Acute leukemia	Acute leukemia
103	Hypercellular marrow	Mild erythroid prominence with Normoblastic maturation with f/o dyserythropoiesis < 10%	Orderly cell maturation	Normal	-	-	9	14	38	-	-	-	39	1.5:1	-	4+	Hemolytic anemia	Hemolytic anemia
104	Dry Tap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry tap	Myelofibrosis
105	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	6+	Non Hodgkin lymphoma	Non Hodgkin lymphoma
106	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Depressed with normal morphology	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Suspicious of malignancy	Metastatic carcinomatous deposits

S. No.	Other relevant investigation_Serum iron profile	Serum B12	Folate	Other infective etiology work up	Myeloma workup profile	Cytogenetic studies	Flowcytometry findings	IHC findings	Any other	Final diagnosis
71	-	-	-	-	-	-	-	-	Stool for occult blood- Positive	HLH
72	-	-	-	-	-	-	-	-	-	Myelofibrosis
73	-	-	-	-	-	-	-	-	-	Plasma cell leukemia
74	29.4 pg/dl	-	-	-	-	FISH- Negative	-	-	-	Megaloblastic anemia
75	-	-	-	-	-	-	-	-	-	Multiple myeloma
76	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
77	-	635	8.35	-	-	-	-	-	-	Hemolytic anemia
78	-	-	-	-	IFE- IgG Kappa monoclonal gammopathy, SPE- M spike seen	-	-	-	CA-13 increased, creatinine-2.75	Multiple myeloma
79	-	-	-	Cocobacilli- Positive	-	-	-	-	-	HLH
80	-	-	-	Beta- D glucan fungital assay & galactomannan- Positive	SPE- no M spike seen	-	-	-	-	Aplastic anemia
81	-	-	-	-	-	-	ALL	-	-	ALL
82	-	-	-	-	SPE- no M spike seen, Urine for bense jone protein- Positive	-	-	-	-	Normocellular normoblastic marrow
83	-	-	-	-	-	-	-	-	-	Metastatic carcinoma with metastasis to bone marrow likely Carcinoma lung
84	-	1486	19.9	-	-	-	-	-	-	Normocellular normoblastic marrow
85	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
86	-	-	-	-	-	-	-	-	-	MDS
87	-	-	-	Galactomannan- Positive, Leptospira IgM- positive	-	-	-	-	Covid- Positive	Leukemoid reaction
88	-	-	-	-	SPE- Mini M spike seen, IFE- IgG Kappa monoclonal gammopathy	-	-	-	-	MGUS
89	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
90	-	-	-	-	SPE- 414/21	-	-	-	-	Normocellular normoblastic marrow
91	-	-	-	Beta 1-3 Glucan- Positive	SPE- 429/21, IFE- 133/21	-	-	-	-	Leukemoid reaction
92	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
93	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
94	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
95	-	-	-	-	SPE-459/21	-	-	-	-	Anemia of chronic disorder
96	-	-	-	-	SPE-464/21, IFE- 137/21	-	-	-	-	Anemia of chronic disorder
97	-	-	-	-	-	-	-	-	-	CLL
98	-	-	-	-	-	-	-	-	-	Megaloblastic anemia
99	-	-	-	-	-	-	-	-	-	Megaloblastic anemia
100	-	-	-	-	-	-	-	-	-	HLH
101	-	-	-	-	-	-	-	-	-	MDS
102	-	-	-	-	-	-	-	Tdt, CD-20, CD-34 & CD-10 - Positive, CD-3 & CD-117 - Negative	-	ALL
103	-	-	-	-	-	-	-	-	-	Hemolytic anemia
104	-	-	-	-	-	MPN panel JAK2V617F mutation detected	-	-	-	Myelofibrosis
105	-	-	-	-	-	-	-	Present	-	Diffuse large B- cell lymphoma
106	-	-	-	-	-	-	-	-	-	Multiple myeloma
107	-	-	-	-	-	-	-	Present	-	Metastatic carcinomatous deposits likely primary in prostate

S. No.	MRD No.	Hematology No.	Surg. Path No.	Name	Age	Sex	Date	Chief presenting complaints	Petechiae	Burning micturition	Haemoptysis	SKIN MANIFESTATION	Loose stool	Melena	Weakness	Abdominal pain	Anemia	Backache	FEVER	Shortness of breath	Loss of weight	Loss of appetite	PAIN	BLEEDING	COUGH	OTHER	Past history	Family history	Personal history	General physical examination
108	1160014	21-600	21-7557	JS	62	M	24/8/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
109	1157631	21-604	21-7569	M	65	M	24/8/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
110	349739	21-606	21-7577	J	69	M	24/8/2021	Weakness, Loss of appetite	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	HTN	-	-	-
111	1161322	21-609	21-7664	SS	60	F	26/8/2021	Weakness, Rash all over body, Ulcer in the mouth	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	Grandmother- Breast cancer	-	-
112	1163987	21-625	21-7805	H	69	M	30/8/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
113	823014	21-635	21-7877	JS	69	M	31/8/2021	Weakness, bachache	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N	-	-	-	-
114	594587	21-642	21-7955	VK	67	M	09-02-2021	Cough, loose stools	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	N	Treated case of leprosy	-	-	-
115	1165975	21-645	21-7964	BR	68	M	09-02-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
116	1159726	21-647	21-7985	S	60	F	09-03-2021	Weakness, Vomting	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	HTN, DM, Backache, HCV	-	-	-
117	1168756	21-655	21-8129	DSK	74	M	09-07-2021	Abdominal pain	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	HTN, DM, Genitourinary TB	-	-	-
118	1003045	21-656	21-8168	J	64	M	09-08-2021	Fever, Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	Y	N	Y	N	N	N	N	N	HTN	-	-	-
119	1169782	21-657	21-8166	N	71	F	09-08-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
120	746142	21-665	21-8240	S	62	F	09-09-2021	Breathlessness, Cough	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	K/c/o- Carcinoma breast(right), DM	-	-	-
121	1169119	21-669	21-8309	VD	61	M	09-10-2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	DM	-	-	-
122	1170331	21-668	21-8300	R	62	M	09-10-2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	-	-	Alcoholic	-
123	563460	21-679	21-8458	DNM	73	F	15/9/2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	K/c/o- Sjogren's syndrome	-	-	-
124	1173438	21-684	21-8475	PK	65	F	15/9/2021	Weakness, Ecchymosis	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	DM, Hypothyroidism	-	-	-
125	1165472	21-694	21-8560	MK	64	F	17/9/2021	Fever, Loss of appetite	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	HTN, DM	-	-	-
126	1175824	21-695	21-8602	BS	67	M	18/9/2021	Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	DM	-	-	-
127	1176620	21-701	21-8644	BS	61	M	20/9/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	Smoking	-
128	1175660	21-703	21-8673	BS	70	M	20/9/2021	Loss of speech, altered sensorium	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	DM, Hypothyroidism	-	-	Pallor
129	1174413	21-706	21-8711	CS	72	M	21/9/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HCV	-	Alcoholic	-
130	1177503	21-708	21-8731	RK	74	F	22/9/2021	Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	HTN, K/c/o carcinoma left breast	-	-	-
131	195589	21-709	21-8795	SK	63	F	22/9/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Chemotheropy	-	-	-
132	1179621	21-712	21-8841	C	61	F	24/9/2021	Weakness, Thrombocytopenia	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	HTN, Hypothyroidism	-	-	-
133	1169559	21-721	21-9018	DR	70	F	29/9/2021	Abdominal pain, Incidental Thrombocytopenia	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	Y	HTN, DM	-	-	-
134	1183194	21-732	21-9125	NNS	82	M	10-01-2021	Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	HTN	-	-	Purpura spots
135	1184392	21-739	21-9215	DN	69	M	10-04-2021	Weakness, Bachache, Loss of weight	N	N	N	N	N	N	Y	N	N	Y	N	N	Y	N	N	N	N	N	-	-	-	-
136	1184123	21-741	21-9245	Kk	70	F	10-05-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
137	1184417	21-742	21-9259	GS	65	M	10-05-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
138	1183984	21-754	21-9404	PL	70	F	10-08-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN, TB	-	-	-
139	1123894	21-758	21-9440	B	65	M	10-09-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	DM	-	Alcoholic	Petechiae
140	1186994	21-759	21-9444	HS	61	M	10-09-2021	Weakness, Joint Pain	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N	Bronchial Asthma	-	-	-
141	1189388	21-764	21-9489	JS	67	M	10-11-2021	Weakness, Thrombocytopenia	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	HTN	-	-	-
142	1189952	21-767	21-9536	AK	60	F	10-12-2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	Bronchial Asthma	-	-	-
143	432189	21-770	21-9549	RLK	65	M	10-12-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Cirrhosis, TB, DM	-	-	Pallor
144	1190503	21-782	21-9644	NB	62	F	14/10/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
145	1191000	21-790	21-9776	H	68	M	19/10/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
146	1192825	21-793	21-9825	K	64	M	20/10/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	Thrombosis left leg	-	-	-
147	1176199	21-796	21-9866	HC	65	M	21/10/2021	Shortness of breath, Weakness	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	N	N	HTN, DM	-	-	-

S. No.	P/A examination	Indication for bone marrow	HB	RBC	TLC	Neutrophils	Lymphocytes	Monocytes	Eosinophils	Basophils	Promyelocytes	Myelocytes/ Metamyelocytes	Plasma cells	Blasts/ Atypical cells	nRBC/100 WBC	Platelets	ESR	Corrected retic	Normocytes	Smudge cell	Roulex formation	Anisocytosis	Microcytes	Anisopiokilocytosis	Macroovalocytes	Macrocytes	Tear drop cells
108	-	Thrombocytopenia	12.3	-	5.6	55	35	8	2	-	-	-	-	-	-	60	-	0.49	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
109	-	Pancytopenia	7.3	-	0.7	10	8	1	1	-	-	-	-	-	-	120	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
110	-	Anemia	7	-	13.5	82	10	6	2	-	-	-	-	-	-	392	-	0.14%	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
111	-	Hypereosinophilic syndrome	12.3	-	28	18	10	2	70	-	-	-	-	-	-	228	-	0.90%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
112	-	Bicytopenia	8.3	-	4.9	35	50	10	5	-	-	-	-	-	-	48	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
113	-	Hypercalcemia under evaluation	7.3	-	9.2	70	20	8	2	-	-	-	-	-	-	179	-	1.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
114	-	Pancytopenia	4.8	-	3.9	33	57	10	-	-	-	-	-	-	-	74	-	1.40%	Absent	Absent	Absent	Present	Present	Absent	Present	Present	Absent
115	Splenomegaly	Leucocytosis	10	-	439	4	94	2	-	-	-	-	-	-	-	157	-	1.30%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
116	-	Acute febrile ilness	7.3	-	21.4	83	10	4	3	-	-	-	-	-	-	170	-	0.60%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
117	Splenomegaly	Myeloprolifirative neoplasm	13.1	-	87	59	2	-	2	1	1	34	-	1	-	259	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
118	Hepatomegaly, Splenomegaly	? Leukemia ? Tropical Fever	10.5	-	7	22	28	8	2	-	-	-	-	40	-	54	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
119	Splenomegaly	Thrombocytosis	10.1	-	7.7	77	10	7	6	-	-	-	-	-	-	562	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
120	-	Multiple myeloma	7.5	-	8.6	62	28	8	2	-	-	-	-	-	-	238	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
121	Splenomegaly	MAS/Myeloprolifirative disease/Leukemoid reaction	9.7	-	52.4	71	18	6	-	-	-	5	-	-	-	62	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
122	-	AML	7.2	-	16.2	20	28	4	-	-	2	M10, MM6	-	30	-	98	-	-	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
123	Splenomegaly	Acute febrile ilness	7.7	-	12	85	10	2	-	-	-	3	-	-	-	114	-	1.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
124	-	Aplastic anemia	7.9	-	0.5	9	7	3	6	-	-	-	-	-	-	32	-	0.10%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
125	Hepatomegaly	Acute Leukemia	8.6	-	10.6	35	30	12	1	-	-	-	-	-	10	98	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Present	Absent
126	-	ITP	11.7	-	10.3	68	28	4	-	-	-	-	-	-	-	81	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent
127	-	Hairy cell leukemia	6.2	-	1.2	15	80	5	-	-	-	-	-	-	-	110	-	-	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
128	-	Pancytopenia	8.2	-	0.3	1	4	-	-	-	-	-	-	-	-	20	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
129	-	To rule out leukemia	8.4	-	20	42	38	20	-	-	-	-	-	-	-	100	-	2.50%	Absent	Absent	Absent	Absent	Present	Present	Absent	Present	Absent
130	-	CML	10.9	-	17.8	60	14	1	4	-	1	16	-	B1	3	600	-	3.40%	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
131	Hepatomegaly	BCR-ABL - Positive, CML	7.1	-	26.5	70	10	8	2	-	-	10	-	-	-	338	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
132	-	ITP	14	-	12.5	70	20	8	2	-	-	-	-	-	-	60	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
133	Hepatomegaly	Thrombocytopenia	12.4	-	8.2	50	40	8	2	-	-	-	-	-	-	102	-	0.70%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
134	-	-	8.1	-	54.1	12	82	4	2	-	-	-	-	-	-	90	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
135	-	Multiple myeloma	9	-	7.3	60	35	3	2	-	-	-	-	-	-	339	-	0.10%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
136	Hepatomegaly	Myelodysplastic syndrome	10.4	-	2.6	55	40	4	1	-	-	-	-	-	-	54	-	0.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
137	-	Myeloproliferative neoplasm	14.8	-	55.9	60	10	4	2	-	2	20	-	B2	-	341	-	0.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
138	-	Acute febrile ilness with thrombocytopenia	8.1	-	18	70	25	4	1	-	-	-	-	-	-	106	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
139	-	Leucocytosis	10.5	-	25.4	80	8	8	2	-	-	3	-	-	-	480	-	0.20%	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
140	Hepatosplenomegaly	Pancytopenia	6.7	-	4.2	53	26	5	1	-	-	3	-	B12	-	171	-	-	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
141	-	Thrombocytopenia	14.7	-	7	72	18	7	3	-	-	-	-	-	-	70	-	0.80%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
142	-	Thrombocytopenia	15.7	-	9.6	50	40	8	2	-	-	-	-	-	-	79	-	0.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
143	Splenomegaly	Pancytopenia	4.3	-	1.3	66	24	10	-	-	-	-	-	-	-	64	-	0.40%	Present	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent
144	-	-	4.2	-	14.6	20	10	4	2	-	-	-	-	B64	-	256	-	0.90%	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Present
145	-	Multiple myeloma	8.6	-	9.4	85	10	4	1	-	-	-	-	-	-	314	-	0.90%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
146	Hepatosplenomegaly	Myeloproliferative neoplasm	14.7	-	143.4	52	3	2	5	2	3	30	-	B3	1	422	-	1.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
147	Hepatomegaly	Hematolymphoid malignancy	7.6	-	6.8	39	46	7	-	-	-	-	-	8	-	66	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent

S. No.	Target cells	Pencil Cells	Normochromia	Hypochromia	Neutrophilia	Neutropenia	Eosinophilia	Monocytosis	Lymphocytosis	Leucocytosis	Leucopenia	Platelets	CT	PET	X-Ray	MRI	USG	Bone marrow aspiration_Site	Aspiration
108	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	No fregments obtained
109	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	No fregments obtained
110	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (left side)	Fragments present
111	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
112	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
113	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	cervicodorsal spine-spondylotic disease of spine	-	Posterior superior iliac spine (right side)	Fragments present
114	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
115	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
116	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
117	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
118	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
119	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
120	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
121	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
122	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
123	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
124	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
125	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
126	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
127	Absent	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	No fregments obtained
128	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Dry tap
129	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
130	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
131	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
132	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
133	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
134	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
135	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
136	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
137	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
138	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
139	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
140	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
141	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
142	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
143	Absent	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
144	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
145	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
146	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
147	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present

S. No.	Cellularity	Erythropoiesis	Leucopoiesis	Megakaryocytes	Blasts	Promyelocytes	Myelocytes	Metamyelocytes	Neutrophils	Eosinophils	Lymphocytes	Plasma cells	Erythroid cells	M:E Ratio	MPO	Iron	Bone marrow aspiration diagnosis	Bone marrow biopsy diagnosis
108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3+	Hypocellular marrow	Hypocellular marrow
109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Hypocellular marrow	Hypocellular marrow
110	Normocellular marrow	Normoblastic maturation with megaloblastoid change	Orderly cell maturation	Adequate	-	-	12	22	34	6	-	4	22	3.5:1	-	Reduced	Iron deficiency anemia	Iron deficiency anemia
111	Hypercellular marrow	Normoblastic maturation	Myeloid prominence with p/o eosinophils & eosinophilic precursors constituting 60% of all nucleated cells	Adequate in number & morphology	-	-	10	8	10	60	-	2	10	8.0:1	-	Reduced	Hypereosinophilic syndrome	Hypereosinophilic syndrome
112	Hypercellular marrow	Depressed with normoblastic maturation & f/o dyserythropoiesis > 10%	Myeloid prominence with p/o hypogranular forms. Blast cells- 20% of nucleated cells	present with p/o dysmegakaryopoiesis	-	-	-	-	-	-	-	-	-	-	-	5+	MDS with multilineage dysplasia	MDS with multilineage dysplasia
113	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	2+	Multiple myeloma	Multiple myeloma
114	Hypercellular marrow	Erythroid hyperplasia with normoblastic as well as megaloblastic maturation	Orderly cell maturation with p/o few giant metamyelocytes	Adequate in number & morphology	-	-	1	5	8	2	-	-	84	1.0:5	-	Reduced	Dual deficiency anaemia	Dual deficiency anemia
115	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	CLL	CLL
116	Normocellular marrow	Normoblastic maturation with megaloblastoid	Orderly cell maturation	Normal in numbers and mophology	-	6	10	14	30	-	-	10	30	2.0:1	-	Reduced	Normocellular normoblastic marrow	Normocellular normoblastic marrow
117	Hypercellular marrow	Depressed with normoblastic maturation	Myeloid hyperplasia with prominence of myelocytes & metamyelocytes	Hyperplasia with Dwarf forms	2	1	20	24	37	8	-	-	8	11.5:1	-	-	CML in chronic phase	CML in chronic phase
118	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Present	-	-	-	-	-	-	-	-	-	-	-	-	Acute leukemia	ALL
119	Hypercellular marrow	Erythroid prominence with normoblastic maturation	Orderly cell maturation	Hyperplasia with large hyperlobated & atypical megakaryocytes	-	-	2	10	38	7	-	1	42	1.3:1	-	Reduced	ET	ET
120	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	9	18	45	3	-	4	24	3.5:1	-	2+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
121	Hypercellular marrow	Depressed with normoblastic maturation	Myeloid hyperplasia with prominent granules & orderly cell maturation	Normal	2	-	10	18	58	2	-	-	10	9.0:1	-	5+	Leukemoid reaction	Leukemoid reaction
122	Hypercellular marrow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Acute leukemia	AML
123	Hypercellular marrow	Normoblastic maturation	Myeloid prominence	Adequate in number & normal in morphology	-	-	16	15	46	-	3	5	15	5.0:1	-	6+	Leukemoid reaction	Leukemoid reaction
124	Hypocellular marrow	Depressed with normoblastic maturation & f/o dyserythropoiesis > 10%	Maturation arrest at myelocyte stage with f/o dysplasia > 10 %	Normal	-	-	9	19	32	3	-	7	30	2.0:1	-	4+	MDS with multilineage dysplasia	MDS with multilineage dysplasia
125	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal	-	-	6	10	23	2	5	12	42	01:01	-	6+	plasma cell dyscrasia	Multiple myeloma
126	Normocellular marrow	Slight prominence with normoblastic maturation	Orderly cell maturation	Normal	-	-	12	20	24	4	-	-	40	1.5:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
127	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Lymphoproliferative disorder	Hairy cell leukemia
128	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry tap	Hypocellular marrow
129	Patchily cellular marrow	Normoblastic maturation	Prominence of myelocytes & metamyelocytes with f/o dysmyelopoiesis > 10%, Atypical blastoid ceii- 30 %	Present with dysplastic forms	-	-	-	-	-	-	-	-	-	-	-	Reduced	Acute leukemia	AML
130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Myelofibrosis
131	Hypercellular marrow	Depressed with normoblastic maturation	Myeloid hyperplasia with orderly cell maturation	Megakaryocytic hyperplasia	-	-	8	28	50	4	-	2	8	11.0:1	-	4+	CML in chronic phase	CML in chronic phase
132	Cellular marrow	Normoblastic maturation	Orderly cell maturation	Prominence	-	-	8	15	35	7	3	6	26	2.5:1	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
133	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent	-	-	10	10	4	3	2	5	30	2.0:1	-	4+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
134	Hypercellular marrow	Normoblastic maturation with mild megaloblastic change	Orderly cell maturation	Present	-	-	-	-	-	-	-	-	-	-	-	Reduced	Lymphoprolifirative neoplasm	CLL
135	Cellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers and mophology	-	-	4	10	20	-	-	50	16	2.0:1	-	Reduced	Multiple myeloma	Multiple myeloma
136	Hypercellular marrow	Normoblastic maturation & megaloblastoid change with f/o dyserthropoiesis > 10 %	Orderly cell maturation with giant myelocytes & metamyelocytes	F/o dysmegakaryopoiesis in > 10 %	-	-	10	18	27	2	-	3	50	1.0:1	-	4+	MDS with multilineage dysplasia	MDS with multilineage dysplasia
137	Hypercellular marrow	Normoblastic maturation	Myeloid hyperplasia with orderly cell maturation	Megakaryocytic hyperplasia with many monolobated & hyperlobated forms	-	-	16	22	37	12	-	-	13	7.0:1	-	Reduced	CML in chronic phase	CML in chronic phase
138	Cellular marrow	Erythroid prominence with normoblastic maturation	Orderly cell maturation	Prominent	-	-	2	4	30	2	4	2	56	1.5:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
139	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	12	22	38	2	-	1	25	3.0:1	-	3+	Normocellular normoblastic marrow	Normocellular normoblastic marrow
140	Hypercellular marrow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ALL	ALL
141	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	15	20	25	5	1	3	32	2.0:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
142	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	10	10	43	5	5	-	27	2.5:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
143	Hypercellular marrow	Erythroid hyperplasia with megaloblastoid change & s/o dyserythropoiesis (< 10 %)	Relatively depressed with orderly cell maturation. Few giant myelocytes seen	Adequate	-	-	5	4	12	2	8	-	69	1.0:3	-	Reduced	Megaloblastic anemia	Megaloblastic anemia
144	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	Reduced	Acute leukemia	ALL
145	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Normal	-	-	18	15	33	2	-	2	30	2.5:1	-	2+	Normocellular normoblastic marrow	Non Hodgkin lymphoma-High grade B- cell type
146	Hypercellular marrow	Relatively depressed with normoblastic maturation	Marked myeloid hyperplasia with prominence of myelocytes & metamyelocytes	Hyperplasia with few dwarf forms	6	3	20	31	30	4	-	-	6	15.0:1	-	2+	CML in chronic phase	CML in chronic phase
147	Hypercellular marrow	Relatively depressed with normoblastic maturation & f/o dyserythropoiesis < 10%	Relatively depressed	Present with f/o dysmegakaryopoiesis < 10%	-	-	-	-	-	-	-	-	-	-	-	6+	Hematolymphoid malignancy	AML

S. No.	Other relevant investigation_Serum iron profile	Serum B12	Folate	Other infective etiology work up	Myeloma workup profile	Cytogenetic studies	Flowcytometry findings	IHC findings	Any other	Final diagnosis
108	-	-	-	-	-	-	-	-	-	Aplastic anemia
109	-	-	-	-	-	-	-	-	-	Aplastic anemia
110	-	-	-	-	-	-	-	-	-	Iron deficiency anemia
111	-	-	-	-	-	-	-	-	ANA- positive	Hypereosinophilic syndrome
112	-	-	-	-	-	-	-	-	-	MDS
113	-	-	-	-	-	-	-	-	-	Multiple myeloma
114	-	-	-	-	-	-	-	-	-	Dual deficiency anemia
115	-	-	-	-	-	-	CLL	Present	-	CLL
116	-	-	-	-	IFE-165/21	-	-	-	-	Normocellular normoblastic marrow
117	-	-	-	-	-	-	-	-	-	CML in chronic phase
118	-	-	-	-	-	-	ALL	-	-	ALL
119	-	-	-	-	-	t(1.4:11)-RQPCR BCR/ABL-Negative	-	-	-	ET
120	-	-	-	-	Bencejone protein- Positive	-	-	-	-	Normocellular normoblastic marrow
121	-	-	-	-	-	-	-	-	Lap score- 249/21	Leukemoid reaction
122	-	-	-	-	-	-	AML	-	-	AML
123	-	-	-	-	-	-	-	-	-	Leukemoid reaction
124	-	-	-	-	-	-	-	-	-	MDS
125	-	-	-	-	-	-	-	Present	-	Multiple myeloma
126	-	-	-	HPLC- Beta Thalassaemia trait	-	-	-	-	-	Hyperdestructive thrombocytopenia
127	-	-	-	-	-	-	Present	-	-	Hairy cell leukemia
128	-	-	-	-	-	-	-	-	Culture- Enterobacteriaceae positive	Aplastic anemia
129	-	-	-	-	-	-	Present	-	-	AML
130	-	-	-	-	-	-	-	-	Masson's trichrome stain & reticulin stain- Grade 3 fibrosis	Myelofibrosis
131	-	-	-	-	-	-	-	-	-	CML in chronic phase
132	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
133	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
134	-	-	-	-	-	-	Present	-	-	CLL
135	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
136	-	-	-	-	-	-	-	-	Stools- Cysts of giardia lamblia-Detected	MDS
137	-	-	-	-	-	-	-	-	Lap- Low (15)	CML in chronic phase
138	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
139	-	-	-	-	-	-	-	-	-	Normocellular normoblastic marrow
140	-	-	-	-	-	-	-	-	-	ALL
141	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
142	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
143	-	-	-	-	-	-	-	-	-	Megaloblastic anemia
144	-	-	-	-	-	-	-	-	-	ALL
145	-	-	-	-	-	-	-	Present	-	Non Hodgkin lymphoma- High grade B- cell type
146	-	-	-	-	-	-	-	-	-	CML in chronic phase
147	-	-	-	-	-	-	Present	-	-	AML

S. No.	MRD No.	Hematology No.	Surg. Path No.	Name	Age	Sex	Date	Chief presenting complaints	Petechiae	Burning micturition	Haemoptysis	SKIN MANIFESTATION	Loose stool	Melena	Weakness	Abdominal pain	Anemia	Backache	FEVER	Shortness of breath	Loss of weight	Loss of appetite	PAIN	BLEEDING	COUGH	OTHER	Past history	Family history	Personal history	General physical examination
148	1193412	21-799	21-9898	SK	71	M	22/10/2021	Weakness, Abdominal pain	N	N	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
149	1194106	21-802	21-9946	BLV	73	M	23/10/2021	Weakness, Nose bleed	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	-	-	-	-
150	429270	21-805	21-9988	SRK	77	M	25/10/2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	HTN, AKI, Polyserositis	-	-	-
151	1185727	21-808	21-10063	DK	63	F	27/10/2021	Weakness, Loss of appetite	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	-	-	-	-
152	1198737	21-811	21-10149	V	87	M	29/10/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
153	1196760	21-813	21-10218	AS	84	M	30/10/2021	Cough, Shortness of breath	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	-	-	-	-
154	1201179	21-818	21-10277	AR	61	M	11-02-2021	Weakness, Hemoptysis with cough	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	Y	N	-	-	-	-
155	1197895	21-819	21-10293	P	63	M	11-02-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
156	1201912	21-823	21-10345	KS	62	M	11-04-2021	Fever, Anemia	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	N	N	N	N	-	-	-	-
157	1085497	21-826	21-10364	SR	62	F	11-06-2021	Purpura, Petechiae	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN, DM	-	-	-
158	1199663	21-828	21-10369	JP	63	M	11-06-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
159	1202358	21-829	21-10397	SK	60	F	11-08-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
160	291361	21-832	21-10415	JC	68	M	11-08-2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	CKD,DM	-	-	-
161	1203172	21-833	21-10423	C	64	F	11-08-2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	Dengue	-	-	-
162	1202956	21-835	21-10425	A	84	M	11-08-2021	Drowsiness	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN	-	-	-
163	1199060	21-836	21-10436	G	82	F	11-08-2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	HTN	-	-	-
164	620213	21-842	21-10468	BS	67	M	11-09-2021	Fever, increase in creatinine	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	HTN, TB	-	-	-
165	1206290	21-857	21-10589	KR	63	F	11-12-2021	Weakness, Loss of weight	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	-	-	-	-
166	1205938	21-858	21-10595	PD	65	F	11-12-2021	Fever, Loss of appetite	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	-	-	-	-
167	998101	21-864	21-10694	TK	62	F	11-12-2021	Knee Pain	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	DM	-	-	-
168	953737	21-865	21-10698	Mk	74	F	15/11/2021	Backache, Melena	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	N	K/c/o Carcinoma duodenum (metastatic adenocarcinomatous deposits)	-	-	-
169	1131523	21-866	21-10700	HL	69	M	15/11/2021	Weakness, Nose bleed, Hemoptysis	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	K/c/o- CKD	-	-	-
170	1204801	21-867	21-10722	L	67	M	15/11/2021	Weakness, Fever	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTN, DM	-	-	-
171	1197404	21-868	21-10724	BR	74	M	15/11/2021	Pain right flank, Abdominal distension	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	-	-	-	-
172	1206702	21-869	21-10726	MS	70	M	15/11/2021	Fever, Black coloured stools	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	K/c/o Carcinoma rectum	-	-	-
173	1212675	21-901	21-11219	SLS	92	M	27/11/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	DM	-	-	-
174	1208367	21-870	21-10753	RLS	65	M	16/11/2021	Fever, Dengue	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	HTN	-	-	-
175	1208598	21-871	21-10751	J	66	F	16/11/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	K/c/o CML	-	-	-
176	1208373	21-877	21-10863	RD	66	F	18/11/2021	Fever, Petechiae	Y	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
177	1210341	21-878	21-10913	LD	73	F	19/11/2021	Difficulty in speaking, Purpura	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	K/c/o- RA, HTN	-	-	-
178	1206702	21-887	21-10992	M	70	M	22/11/2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	K/c/o- Carcinoma Rectum	-	-	-
179	1213046	21-894	21-11136	NS	87	M	25/11/2021	Fever, Weakness	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	HTB	-	-	-
180	1213176	21-896	21-11157	SKJ	89	M	26/11/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
181	544732	21-918	21-11406	M	82	F	12-02-2021	Fracture right leg	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	HTN, DM	-	-	-
182	994285	21-921	21-11444	RS	74	M	12-03-2021	Haemoptysis	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	K/c/o- ITP, HTN	-	-	-
183	556188	21-923	21-11468	DS	71	M	12-04-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
184	1182203	21-926	21-11510	CDM	68	M	12-06-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
185	1218881	21-928	21-11519	AS	64	M	12-06-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
186	1215013	21-936	21-11591	PKG	65	M	12-08-2021	Fever	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
187	1043836	21-939	21-11620	UJ	67	F	9/12/201	Ptosis in left eye	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	-	-	-	-

S. No.	P/A examination	Indication for bone marrow	HB	RBC	TLC	Neutrophils	Lymphocytes	Monocytes	Eosinophils	Basophils	Promyelocytes	Myelocytes/ Metamyelocytes	Plasma cells	Blasts/ Atypical cells	nRBC/100 WBC	Platelets	ESR	Corrected retic	Normocytes	Smudge cell	Roulex formation	Anisocytosis	Microcytes	Anisopiokilocytosis	Macroovalocytes	Macrocytes	Tear drop cells
148	Splenomegaly	Leukemia	9.2	-	5.8	9	13	8	-	-	-	-	-	75	-	64	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
149	Splenomegaly	Pancytopenia	8.4	-	4.2	65	28	6	1	-	-	-	-	-	-	89	-	0.30%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
150	Hepatomegaly	Thrombocytopenia	10.8	-	9.2	66	26	6	2	-	-	-	-	-	-	20	-	0.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
151	-	Pancytopenia	6.3	-	2.2	20	55	8	2	-	-	-	-	B15	-	100	-	0.40%	Present	Absent	Absent	Present	Present	Absent	Absent	Present	Absent
152	-	CLL	14.7	-	30	15	80	3	2	-	-	-	-	-	-	212	-	0.40%	Present	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
153	-	Pancytopenia	6.8	-	1.8	51	41	2	8	-	-	-	-	-	-	15	-	1.20%	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent
154	-	Pancytopenia	5.2	-	1.9	35	59	5	1	-	-	-	-	-	-	30	-	1%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
155	-	Polycythemia vera	17.4	-	12.8	82	12	6	-	-	-	-	-	-	-	468	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
156	-	Multiple myeloma	6.2	-	5.2	60	28	10	2	-	-	-	-	-	-	248	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
157	-	Thrombocytopenia	9	-	13.2	75	20	3	2	-	-	-	-	-	-	10	-	0.50%	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
158	-	Thrombocytopenia	10.6	-	5.6	60	30	7	3	-	-	-	-	-	-	76	-	0.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
159	-	Pancytopenia under evaluation	6.8	-	0.8	20	75	4	1	-	-	-	-	-	-	14	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
160	-	Bicytopenia	6.8	-	9.4	66	24	6	4	-	-	-	-	-	-	80	-	0.80%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
161	-	ITP	8.9	-	5	70	24	5	1	-	-	-	-	-	-	20	-	0.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
162	-	Pancytopenia	7.6	-	3.7	70	24	5	1	-	-	-	-	-	-	30	-	0.50%	Present	Absent	Absent	Absent	Absent	Present	Present	Present	Absent
163	-	Bicytopenia	8.4	-	7	80	15	5	-	-	-	-	-	-	-	50	-	-	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
164	-	Multiple myeloma	8.9	-	8.2	72	20	6	2	-	-	-	-	-	-	360	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
165	Splenomegaly	CLL	8.9	-	122	20	50	8	2	-	-	-	-	ALC20	-	284	-	0.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
166	Splenomegaly	Pancytopenia	7.4	-	1.4	60	30	7	3	-	-	-	-	-	-	60	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
167	-	Anemia	6.3	-	6.9	70	23	5	2	-	-	-	-	-	-	142	-	0.60%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
168	-	Bicytopenia	5.6	-	5.9	81	10	4	5	-	-	-	-	-	-	57	-	8%	Present	Absent	Absent	Absent	Absent	Present	Present	Present	Absent
169	-	Multiple myeloma	6.4	-	7.8	52	25	9	4	-	-	-	-	Lymphoplasma	-	100	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent
170	-	Pancytopenia	8.5	-	1.1	35	55	7	3	-	-	-	-	-	-	54	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
171	-	Pancytopenia	4.5	-	2.8	66	24	8	2	-	-	-	-	-	-	116	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
172	-	Thrombocytopenia	11.6	-	3.6	56	32	12	-	-	-	-	-	-	3	39	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
173	-	?Cold agglutination disease ?Hematolymphoid malignant ?AIHA	8.9	-	11.9	80	15	3	2	-	-	-	-	-	-	327	-	2.30%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
174	-	ITP	11.8	-	17.5	68	18	8	3	-	-	3	-	-	3	24	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
175	Hepatomegaly	-	13.8	-	9.1	60	25	4	1	-	-	10	-	-	-	40	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
176	-	AFI with thrombocytopenia	11.1	-	15	80	17	3	-	-	-	-	-	-	-	47	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
177	Hepatomegaly	Bicytopenia	12.1	-	2.6	30	56	12	2	-	-	-	-	-	-	79	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
178	-	Thrombocytopenia	11.5	-	8.3	86	8	4	-	-	-	2	-	-	-	51	-	0.10%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
179	-	? MDS, ? Multiple Myeloma	6.1	-	3	44	36	-	-	-	-	8	-	12	6	47	-	3.10%	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
180	-	Multiple myeloma	9.7	-	6	56	33	6	-	-	-	-	-	-	-	244	-	0.80%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
181	-	Multiple myeloma	7.5	-	18	84	14	2	-	-	-	-	-	-	-	42	-	3.20%	Present	Absent	Absent	Present	Absent	Absent	Absent	Present	Absent
182	-	ITP	12	-	5.2	68	28	4	-	-	-	-	-	-	-	45	-	0.20%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
183	-	Pancytopenia	8.3	-	3.8	51	34	2	-	-	-	-	-	13	-	62	-	0.70%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
184	-	Pancytopenia	9	-	1.1	73	26	-	1	-	-	-	-	-	-	102	-	0.40%	Present	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent
185	-	Multiple myeloma	9	-	10	67	25	2	6	-	-	-	-	-	-	161	-	0.20%	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
186	-	MPN	12	-	24.1	79	11	9	1	-	-	-	-	-	-	1125	-	0.30%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
187	-	Marrow infiltrative disorder	11.3	-	6.5	60	34	6	-	-	-	-	-	-	-	191	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent

S. No.	Target cells	Pencil Cells	Normochromia	Hypochromia	Neutrophilia	Neutropenia	Eosinophilia	Monocytosis	Lymphocytosis	Leucocytosis	Leucopenia	Platelets	CT	PET	X-Ray	MRI	USG	Bone marrow aspiration_Site	Aspiration
148	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
149	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
150	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
151	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
152	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
153	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
154	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (leftt side)	Fragments present
155	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
156	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
157	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
158	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
159	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
160	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
161	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
162	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
163	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
164	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
165	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right & left side)	Fragments present
166	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
167	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
168	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
169	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
170	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
171	Present	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
172	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
173	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (left side)	Fragments present
174	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
175	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
176	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
177	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
178	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
179	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Dry tap
180	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
181	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	Leison in left shaft of femur	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
182	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
183	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
184	Absent	Present	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
185	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
186	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
187	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present

S. No.	Cellularity	Erythropoiesis	Leucopoiesis	Megakaryocytes	Blasts	Promyelocytes	Myelocytes	Metamyelocytes	Neutrophils	Eosinophils	Lymphocytes	Plasma cells	Erythroid cells	M:E Ratio	MPO	Iron	Bone marrow aspiration diagnosis	Bone marrow biopsy diagnosis
148	Hypercellular marrow	Depressed with f/o dyserythropoiesis > 10%	Depressed	Megakaryocytic hyperplasia	-	-	-	-	-	-	-	-	-	-	Negative	-	Acute leukemia	AML
149	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent	-	-	7	17	38	1	2	2	33	2.0:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
150	Cellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	8	12	45	4	2	3	26	-	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
151	Hypercellular marrow	Normoblastic maturation with f/o dyserythropoiesis <10%	Depressed	Depressed	65	-	-	-	-	-	-	5	30	-	-	-	ALL	ALL
152	Hypercellular marrow	Relatively depressed with normoblastic maturation	Relatively depressed with orderly cell maturation	Adequate	-	-	2	4	6	-	70	3	15	-	-	Reduced	CLL	CLL
153	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	Lymphoproliferative disorder	Lymphoplasmacytic lymphoma
154	Hypercellular marrow with increased fat space	Depressed	Depressed	Depressed	-	-	12	6	9	-	12	27	34	-	-	5+	Hypocellular marrow	Hypocellular marrow
155	Hypercellular marrow	Erythroid prominence with normoblastic maturation	Orderly cell maturation	Megakaryocytic prominence with atypical forms	-	-	16	13	28	2	-	-	41	1.4:1	-	Reduced	CML in chronic phase	CML in chronic phase
156	Hypercellular marrow	Depressed	Depressed	Depressed	-	-	-	-	-	-	-	-	-	-	-	-	Multiple myeloma	Multiple myeloma
157	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent with few young forms	-	-	14	19	26	6	-	3	32	2.0:1	-	4+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
158	Cellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent with few young forms	-	-	13	12	36	4	-	3	32	2.0:1	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
159	Hypocellular marrow	Depressed with normoblastic maturation	Depressed	Present	-	-	-	-	-	-	-	-	-	-	-	6+	Hypocellular marrow	Hypocellular marrow
160	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent	-	-	15	17	28	3	8	6	23	2.6:1	-	6+	Anemia of chronic disorder	Anemia of chronic disorder
161	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent with few young forms	-	-	15	16	26	4	2	4	33	1.8:1	-	4+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
162	Hypercellular marrow	Erythroid hyperplasia with megaloblastic maturation	Orderly cell maturation with giant metamyelocytes	Adequate	-	-	6	15	6	-	-	4	69	1.0:2.5	-	5+	Megaloblastic anemia	Megaloblastic anemia
163	Mildly Hypercellular marrow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Reduced	Megaloblastic anemia	Megaloblastic anemia
164	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	18	21	20	-	-	15	26	2.2:1	-	5+	Multiple myeloma	Multiple myeloma
165	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with Orderly cell maturation	Adequate	-	-	-	-	-	-	-	-	-	-	-	-	CLL	CLL
166	Normocellular marrow	Normoblastic maturation with f/o dyserythropoiesis < 6%	Orderly cell maturation	Prominent	-	-	15	18	29	4	8	-	26	2.5:1	-	4+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
167	Hypercellular marrow	Erythroid prominence with normoblastic maturation & megaloblastoid change with f/o dyserthropoiesis 10 %	Orderly cell maturation	Present	-	-	7	1	32	2	5	5	48	1.0:1.4	-	4+	MDS	MDS
168	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	7	7	33	3	-	0	50	01:01	-	3+	Hemolytic anemia	Hemolytic anemia
169	Hypercellular marrow	Depressed	Depressed	Prominent	-	-	-	-	-	-	-	-	-	-	-	Reduced	Plasma cell dyscrasia	Plasma cell dyscrasia
170	Hypercellular marrow	Normoblastic as well as megaloblastic maturation with f/o dyserythropoiesis < 10%	Hyperplasia with orderly cell maturation	Hyperplasia with few atypical form	-	-	24	9	18	4	10	17	18	3.0:1	-	2+	Leishmaniasis	Leishmaniasis
171	Normocellular marrow	Prominence with normoblastic maturation	Orderly cell maturation with prominence of myelocytes & metamyelocytes	Prominent	-	-	17	18	10	2	8	7	38	1.2:1	-	3+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
172	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent	-	-	17	18	10	2	8	7	38	1.2:1	-	-	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
173	Hypercellular marrow	Erythroid hyperplasia with normoblastic & megaloblastic maturation	Orderly cell maturation	Present	-	-	8	4	10	2	10	5	61	1.0:2.8	-	3+	Autoimmune hemolytic anemia	Autoimmune hemolytic anemia
174	Hypercellular marrow	Erythroid prominence with megaloblastic maturation & f/o dyserthropoiesis < 10 %	Orderly cell maturation	Adequate	-	-	8	12	18	-	-	2	60	1.0:1.5	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
175	Hypercellular marrow	Depressed	Myeloid prominence	Hyperplasia with Dwarf forms	3	-	26	22	23	7	5	3	11	6.5:1	-	6+	CML in chronic phase	CML in chronic phase
176	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent	-	-	5	2	40	6	3	5	39	1.3:1	-	5+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
177	Hypercellular marrow	Erythroid prominence with normoblastic & megaloblastic maturation with f/o dyserthropoiesis 10 %	Maturation arrest with paucity of neutrophils	Hyperplasia	-	-	40	7	1	2	6	1	43	1.1:1	-	6+	Megaloblastic anemia	Megaloblastic anemia
178	Hypocellular marrow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Reduced	Hypocellular marrow	Hypocellular marrow
179	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dry tap	Myelofibrosis
180	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in numbers	-	-	6	4	11	4	8	45	22	1.1:1	-	3+	Multiple myeloma	Multiple myeloma
181	Hypercellular marrow	Normocellular & megaloblastic maturation	Orderly cell maturation	Prominent	-	-	-	-	-	-	-	62	-	-	-	-	Multiple myeloma	Multiple myeloma
182	Hypocellular marrow	Normocellular & megaloblastic change	Orderly cell maturation	Prominence with focal clustering & young forms	-	-	12	7	31	1	6	1	40	1.3:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
183	-	Erythroid prominence with normoblastic maturation	-	Hyperplasia with focal clustering with few hypolobated forms	-	-	-	-	-	-	-	-	-	-	-	-	MDS/MPN	MDS/MPN
184	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Non Hodgkin lymphoma-Mantle cell lymphoma
185	Hypercellular marrow	Depressed	Depressed	Present	-	-	-	-	-	-	-	-	-	-	-	3+	Plasma cell dyscrasia	Plasma cell dyscrasia
186	Hypercellular marrow	Normoblastic maturation with megaloblastoid change	Orderly cell maturation	Hyperplasia with hyperlobated & hypolobated forms	-	-	20	12	32	3	-	5	28	2.5:1	-	Reduced	ET	ET
187	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Normal in number & morphology	-	-	15	4	33	5	3	2	38	1.5:1	-	3+	Clusters of atypical cells	Metastatic carcinomatous deposits

S. No.	Other relevant investigation_Serum iron profile	Serum B12	Folate	Other infective etiology work up	Myeloma workup profile	Cytogenetic studies	Flowcytometry findings	IHC findings	Any other	Final diagnosis
148	-	-	-	-	-	-	Present	-	-	AML
149	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
150	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
151	-	-	-	-	-	-	-	-	-	ALL
152	-	-	-	-	-	-	-	-	-	CLL
153	-	-	-	-	-	-	-	-	-	Lymphoplasmacytic lymphoma
154	-	-	-	-	-	-	-	-	-	Aplastic anemia
155	-	-	-	-	-	-	-	-	-	CML in chronic phase
156	-	-	-	-	-	SPE- no M spike seen	-	-	-	Multiple myeloma
157	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
158	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
159	-	-	-	-	-	-	-	-	-	Aplastic anemia
160	-	-	-	-	-	-	-	-	-	Anemia of chronic disorder
161	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
162	179 pg/dl	-	-	Leptospira IgM- Positive	-	-	-	-	-	Megaloblastic anemia
163	-	-	-	Coomb's test- Negative	-	-	-	-	-	Megaloblastic anemia
164	-	-	-	-	Creatinine-3.14, Urea-54	-	-	Present	-	Multiple myeloma
165	-	-	-	-	-	-	-	Present	-	CLL
166	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
167	76.4 pg/dl	-	-	-	-	-	-	-	-	MDS
168	-	-	-	-	-	-	-	-	-	Hemolytic anemia
169	-	-	-	-	Creatinine-2.8, Urea-76 (IFE-218/21- IgG Kappa monoclonal gammopathy)	-	-	-	-	Multiple myeloma
170	-	-	-	-	-	-	-	-	-	Leishmaniasis
171	-	-	-	-	IFE-220/21	-	-	-	-	Hyperdestructive thrombocytopenia
172	-	-	-	-	-	-	-	-	0	Hyperdestructive thrombocytopenia
173	-	-	-	-	-	-	-	-	ANA- positive, Direct coomb's test-3+, Indirect coomb's test-positive	Autoimmune hemolytic anemia
174	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
175	-	-	-	-	-	-	-	-	-	CML in chronic phase
176	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
177	-	-	-	-	-	-	-	-	-	Megaloblastic anemia
178	-	-	-	-	-	-	-	-	-	Aplastic anemia
179	-	-	-	-	-	-	-	-	-	Myelofibrosis
180	-	-	-	-	SPE- M spike seen	-	-	-	-	Multiple myeloma
181	-	-	-	-	Free kappa/lambda ratio-4.39 increased, free kappa light chain- 44.5 increased	-	-	-	-	Multiple myeloma
182	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
183	-	-	-	-	-	-	-	-	-	MDS
184	-	-	-	-	-	-	-	Present	-	Non Hodgkin lymphoma- Mantle cell lymphoma
185	-	-	-	-	Creatinin-10.45, CA- 7.6, Urine for bence jones protein-Negative	-	-	-	-	Multiple myeloma
186	-	-	-	-	-	-	-	-	LAP score- 146	ET
187	-	-	-	-	-	-	-	Present	-	Metastatic carcinomatous deposits

S. No.	MRD No.	Hematology No.	Surg. Path No.	Name	Age	Sex	Date	Chief presenting complaints	Petechiae	Burning micturition	Haemoptysis	SKIN MANIFESTATION	Loose stool	Melena	Weakness	Abdominal pain	Anemia	Backache	FEVER	Shortness of breath	Loss of weight	Loss of appetite	PAIN	BLEEDING	COUGH	OTHER	Past history	Family history	Personal history	General physical examination
188	1221379	21-946	21-11671	RK	61	M	12-10-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
189	1220255	21-947	21-11668	VDS	65	M	12-10-2021	Weakness, Fever, Petechiae	Y	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N	-	-	-	-
190	1221443	21-949	21-11673	SR	61	M	12-10-2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	-	-
191	1225908	21-968	21-11961	BK	62	F	18/12/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
192	1227671	21-973	21-12067	BK	60	F	22/12/2021	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
193	1223293	21-975	21-12071	PD	60	F	22/12/2021	Shortness of breath	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	HTN	-	-	-
194	1232786	22-04	22-29	BG	60	M	01-02-2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN, DM	-	Tobaco intake	-
195	1208276	22-14	22-206	LG	67	F	01-07-2022	Burning micturition, Shortness of breath	N	Y	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	HTN, DM	-	-	-
196	1235635	22-15	22-204	BS	64	M	01-07-2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	DM	-	-	-
197	1235681	22-16	22-216	NB	63	F	01-07-2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	DM	-	-	-
198	1232459	22-18	22-245	SR	70	F	01-08-2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	DM	-	-	-
199	1234750	22-19	22-264	VP	66	F	01-09-2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
200	1237611	22-25	22-319	KKJ	62	M	01-11-2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Dengue present 3 months back	-	-	-
201	1239035	22-47	22-515	OPS	69	M	19/1/2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	HTN	-	-	-
202	1243725	22-54	22-640	BS	73	M	25/1/2022	Weakness, Loss of appetite, itching on full body	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	DM	-	-	-
203	1245178	22-58	22-709	MN	66	F	28/1/2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
204	992194	22-63	22-731	RLK	61	M	28/1/2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-
206	1240693	22-42	22-485	kgs	84	M	18/1/2022	Weakness	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	-	-	-	-

S. No.	P/A examination	Indication for bone marrow	HB	RBC	TLC	Neutrophils	Lymphocytes	Monocytes	Eosinophils	Basophils	Promyelocytes	Myelocytes/ Metamyelocytes	Plasma cells	Blasts/ Atypical cells	nRBC/100 WBC	Platelets	ESR	Corrected retic	Normocytes	Smudge cell	Roulex formation	Anisocytosis	Microcytes	Anisopiokilocytosis	Macroovalocytes	Macrocytes	Tear drop cells
188	-	CML	8.4	-	39.9	76	2	2	-	1	-	16	-	3	-	364	-	0.50%	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
189	Hepatomegaly	ITP	10.4	-	14	76	16	3	2	-	-	3	-	-	-	27	-	1%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
190	-	Bicytopenia	6.4	-	9	78	15	5	2	-	-	-	-	-	-	76	-	0.50%	Present	Absent	Present	Present	Absent	Absent	Absent	Present	Absent
191	-	Multiple myeloma	9.8	-	17.1	61	35	1	1	-	-	-	2	-	-	219	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
192	-	Persistent thrombocytopenia	15.1	-	4.9	58	31	7	4	-	-	-	-	-	-	86	-	0.50%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
193	-	Multiple myeloma	8	-	6.7	71	18	8	2	-	-	-	1	-	-	184	-	0.60%	Present	Absent	Present	Present	Absent	Absent	Absent	Present	Absent
194	-	Thrombocytopenia	12.7	-	3.6	50	40	8	2	-	-	-	-	-	-	40	-	0.40%	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
195	-	Leucocytosis	6.6	-	31.5	90	3	2	3	-	-	2	-	-	-	760	-	-	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
196	Hepatosplenomegaly	CML	11.3	-	246	57	-	-	1	2	2	32	-	6	-	367	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
197	Hepatomegaly, Splenomegaly	Acute Leukemia	7.3	-	3.2	8	27	5	-	-	-	-	-	60	-	82	-	-	Present	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
198	-	Multiple myeloma	9.3	-	10.5	58	40	2	-	-	-	-	-	-	-	402	-	-	Present	Absent	Present	Present	Present	Absent	Absent	Absent	Absent
199	-	Lymphoproliferative neoplasm	4.9	-	15.7	28	60	6	-	-	-	-	-	6	-	464	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
200	-	ITP	15.4	-	13.3	83	14	3	-	-	-	-	-	-	-	70	-	-	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
201	-	Multiple myeloma	10.3	-	6.5	79	14	6	1	-	-	-	-	-	-	263	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
202	-	Pancytopenia	8	-	3.2	60	30	9	1	-	-	-	-	-	-	48	-	-	Present	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent
203	-	Multiple myeloma	11.2	-	9	72	20	6	2	-	-	-	-	-	-	203	-	-	Present	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent
204	-	Pancytopenia	9.1	-	3.2	58	32	8	2	-	-	-	-	-	-	125	-	3%	Present	Absent	Absent	Absent	Absent	Present	Absent	Present	Absent
206	-	MPN	10.8	-	39.5	77	8	5	10	-	-	-	-	-	-	2627	-	-	Present	Absent	Absent	Absent	Present	Present	Absent	Present	Absent

S. No.	Target cells	Pencil Cells	Normochromia	Hypochromia	Neutrophilia	Neutropenia	Eosinophilia	Monocytosis	Lymphocytosis	Leucocytosis	Leucopenia	Platelets	CT	PET	X-Ray	MRI	USG	Bone marrow aspiration_Site	Aspiration
188	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
189	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
190	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
191	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
192	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Marrow diluted with blood
193	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
194	Absent	Absent	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
195	Absent	Absent	Absent	Present	Present	Absent	Absent	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
196	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
197	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
198	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
199	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Present	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
200	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent	Absent	Present	Absent	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
201	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
202	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
203	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Adequate	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
204	Present	Absent	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent	Present	Reduced	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present
206	Present	Absent	Absent	Present	Present	Absent	Present	Absent	Absent	Present	Absent	Abundant	-	-	-	-	-	Posterior superior iliac spine (right side)	Fragments present

S. No.	Cellularity	Erythropoiesis	Leucopoiesis	Megakaryocytes	Blasts	Promyelocytes	Myelocytes	Metamyelocytes	Neutrophils	Eosinophils	Lymphocytes	Plasma cells	Erythroid cells	M:E Ratio	MPO	Iron	Bone marrow aspiration diagnosis	Bone marrow biopsy diagnosis
188	Hypercellular marrow	Relatively depressed	Hyperplasia with prominence of myelocytes & metamyelocytes	Hyperplasia with few dwarf forms	2	2	28	18	30	10	-	-	10	9.0:1	-	Reduced	CML in chronic phase	CML in chronic phase
189	Hypercellular marrow	Erythroid prominence with normoblastic & megaloblastic maturation	Orderly cell maturation	Hyperplasia with young forms	-	-	12	6	20	2	-	4	56	1.0:1.4	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
190	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate in number & morphology	-	-	-	-	-	-	-	-	-	-	-	2+	Plasma cell dyscrasia	Plasma cell dyscrasia
191	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Present	-	-	-	-	-	-	-	-	-	-	-	Reduced	Plasma cell dyscrasia	Multiple myeloma
192	Normocellular marrow	Erythroid prominence with normoblastic maturation	Orderly cell maturation	Prominent with few young forms	-	-	12	7	14	2	6	3	56	1.0:1.6	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
193	Hypercellular marrow	Relatively depressed	Orderly cell maturation	Present	-	-	2	1	28	2	-	60	7	4.7:1	-	Reduced	Multiple myeloma	Multiple myeloma
194	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Prominent with young forms	-	-	20	19	24	-	-	2	35	1.8:1	-	2+	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
195	Hypercellular marrow	Relatively depressed with normoblastic maturation	Hyperplasia with Orderly cell maturation	Prominent	-	-	12	19	36	4	3	12	14	5.0:1	-	5+	Leukemoid reaction	Leukemoid reaction
196	Hypercellular marrow	Relatively depressed with normoblastic maturation	Myeloid hyperplasia with prominence of myelocytes & metamyelocytes	Prominent with dwarf forms	5	2	18	23	40	2	-	-	8	11.0:1	-	2+	CML in chronic phase	CML in chronic phase
197	Hypercellular marrow	Depressed	Depressed	Depressed	80	-	-	2	-	-	2	8	8	-	Negative	Reduced	Acute leukemia	AML
198	Hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate in number & morphology	-	-	5	10	20	-	-	30	35	1.0:1	-	Reduced	Plasma cell dyscrasia	Plasma cell dyscrasia
199	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Adequate	-	-	-	-	-	-	-	-	-	-	-	2+	Lymphoprolifirative neoplasm	Lymphoplasmacytic lymphoma
200	Normocellular marrow	Normoblastic maturation	Orderly cell maturation	Slightly prominent with few young forms	-	-	18	16	28	4	-	2	32	2.0:1	-	Reduced	Hyperdestructive thrombocytopenia	Hyperdestructive thrombocytopenia
201	Hypercellular marrow	Depressed with normoblastic maturation	Depressed with orderly cell maturation	Present	-	-	-	-	-	-	-	-	-	-	-	Reduced	Multiple myeloma	Multiple myeloma
202	Hypercellular marrow	Normoblastic maturation	Myeloid prominence with orderly cell maturation	Hyperplasia	-	-	15	10	42	5	10	-	18	4.0:1	-	3+	Hypercellular marrow with megakaryocytic hyperplasia & myeloid prominence	Classical Hodgkin lymphoma
203	Mildly hypercellular marrow	Normoblastic maturation	Orderly cell maturation	Adequate	-	-	8	16	38	3	-	35	20	2.1:1	-	2+	Plasma cell dyscrasia	Multiple myeloma
204	Hypercellular marrow	Erythroid hyperplasia with normoblastic & megaloblastic maturation with features of dyserythropoiesis < 10 %	Relatively depressed with orderly cell maturation	Adequate	-	-	5	4	12	-	2	2	75	1.0:3.6	-	2+	Megaloblastic anemia	Megaloblastic anemia
206	Hypercellular marrow	Erythroid prominence with normoblastic maturation	Myeloid prominence with orderly cell maturation	Hyperplasia	-	-	17	33	23	7	-	-	20	04:01	-	Reduced	ET	ET

S. No.	Other relevant investigation_Serum iron profile	Serum B12	Folate	Other infective etiology work up	Myeloma workup profile	Cytogenetic studies	Flowcytometry findings	IHC findings	Any other	Final diagnosis
188	-	-	-	-	-	-	-	-	LAP score- 53	CML in chronic phase
189	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
190	-	-	-	-	Cratinin- 3.73, CA-7.2	-	-	-	-	Multiple myeloma
191	-	-	-	-	SPE- M spike seen, Creatinin- 4.98	-	-	-	-	Multiple myeloma
192	-	-	-	-	-	-	-	-	MP- Positive	Hyperdestructive thrombocytopenia
193	-	-	-	-	SPE- M sike seen	-	-	-	-	Multiple myeloma
194	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
195	-	-	-	-	IFE- Polycolonal gammaopathy	-	-	-	LAP score-201	Leukemoid reaction
196	-	-	-	-	-	-	-	-	Reticulin stain - Grade 2 fibrosis	CML in chronic phase
197	-	-	-	-	-	-	Present	-	-	AML
198	-	-	-	-	SPE- M spike seen, IFE- IgG lambda monoclonal gammopathy, Creatinin-0.3, Calcium-9.2	-	-	-	Free kappa light chain- 70.07, free lambda chain-2764, kappa/lambda ratio- 0.02	Multiple myeloma
199	-	314	20	Ferritin-283	-	-	-	Present	-	Lymphoplasmacytic lymphoma
200	-	-	-	-	-	-	-	-	-	Hyperdestructive thrombocytopenia
201	-	-	-	-	SPE- M spike seen, IFE- IgG lambda monoclonal gammopathy, Creatinin- 1.03, Ca-12.3	-	-	-	-	Multiple myeloma
202	-	-	-	Ferritin-2000, LDH-325	-	-	-	Present	-	Classical Hodgkin lymphoma
203	-	-	-	-	SPE- M spike seen, IFE- IgG lambda monoclonal gammopathy, Creatinin- 0.71	-	-	-	Free kappa light chain- 533, free lambda chain-798, kappa/lambda ratio- 0.66	Multiple myeloma
204	-	249	20	Calcium- 7.5, Iron- 33.9, Ferritin- 10.59	-	-	-	-	-	Megaloblastic anemia
206	-	-	-	-	-	JAK2-V617F- Mutant wild type- Positive	-	-	-	ET

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No. BFUHS/2K21p-TH/ 131 Date 25/1/22

The Principal,
DMC, Ludhiana.

Subject: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 29.10.2021 has approved the plan of thesis of **Nishav**, a student of your college for **MD Pathology** along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Bone marrow findings in geriatric patients.

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The student has to submit the four copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :

97. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*
98. *The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

BONE MARROW FINDINGS IN GERIATRIC PATIENTS

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

PATHOLOGY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

February, 2021

Dr. Nishav

DEPARTMENT OF PATHOLOGY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	BONE MARROW FINDINGS IN GERIATRIC PATIENTS
For the degree of	MD (PATHOLOGY)
Name of the candidate	Dr Nishav
Supervisor	Dr Bhavna Malhotra, Professor, Department of Pathology, DMCH, Ludhiana
Co-supervisor(s)	Dr Dinesh Gupta, Professor and Head, Department of Medicine, DMCH, Ludhiana, Dr Vikram Narang, Associate Professor, Department of Pathology, DMCH, Ludhiana
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Geriatric population is increasing in india due to increasing life expectancy. The elderly age group people are more prone to develop marrow failure, malignancies etc. Hemograms, Peripheral blood smears and Bone marrow examination including both aspiration and biopsy are important investigation for diagnosing the haematological disorders. This study therefore will be conducted to diagnose the hematological disorders in geriatric population by all the above investigations.

Aims & Objectives: To evaluate the hematological disorders in geriatric patients.

Material and method: This will be a descriptive and prospective study total for a period of 12 months from 1 march 2021 to march 2022 which will be conducted in the Department of Pathology, Dayanand Medical College and Hospital, Ludhiana. The geriatric patients (60 and above) will be included and their hemograms, peripheral blood smears and bone marrow examination will be done.

Clinical Significance: With growing number of elderly people, increased incidence of leukaemias, lymphoma, myelodysplastic syndrome (MDS), myeloproliferative neoplasms (MPNs) and multiple myeloma is being observed in the population. Hemograms, Peripheral blood smears and Bone marrow examination are important investigations carried out for the diagnosis and work-up of various hematological and non-hematologic disorders. This study will be conducted to know the diagnosis of hematological disorders in geriatric patients.

Keywords: Hemograms, Peripheral blood smears, Bone marrow Aspiration and Biopsy, elderly patients, anemias, leukaemias, myelodysplastic syndrome

(Signature)	(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"BONE MARROW FINDINGS IN GERIATRIC PATIENTS"** exist in the Department of Pathology, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate herself under our supervision and guidance.

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APPROVAL PROFORMA
BY
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Topic of Thesis	BONE MARROW FINDINGS IN GERIATRIC PATIENTS
Likely date of appearing in PG examination	May 2023
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Dr. Sandeep Puri
Chairperson
Research Committee

Approved: Yes / ~~No~~

Prof. Arvind Malhotra
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BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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2	NAME OF THE INSTITUTE	Dayanand Medical College and Hospital, Ludhiana
3	COURSE OF STUDY AND SUBJECT	MD PATHOLOGY
4	DATE OF ADMISSION OF COURSE	25.07.2020
5	TITLE OF THE TOPIC	Bone marrow findings in geriatric patients

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Hemograms, Peripheral blood smears along with Bone marrow examination are important investigations carried out for the diagnosis and work-up of various hematological and non-hematologic disorders in patientsacross all age groups.With growing number of elderly people, increased incidence of leukaemias, lymphoma, myelodysplastic syndrome (MDS), myeloproliferativeneoplasms (MPNs)and multiple myeloma is being observed. This may be due to age-related changes at the DNA or protein level in various cells and tissues.[1]. Over the past decade, Anemia has grown as an important risk factor and is associated with an array of undesirable outcomes in elder adults, including hospitalization, disability and mortality.Anemia is an insidious disease and is associated with a wide range of negative health conditions in the elderly.

Bone marrow is made up of (a) cellular elements of hemopoietic stem cells, proliferating and differentiating progenitors and morphologically recognizable precursors and (b) stroma. There is a critical interaction between stromal cells and the hemopoietic progenitor cells. Islands of Erythroblasts are seen in central parts of the marrow in close proximity to sinusoids. Myeloblasts are frequently found adjacent to the trabecular surfaces. Megakaryocytes are normally present in the central parts of the bone marrow amongst the erythroid and myeloid precursors. Monocytic precursors are usually not recognizable in the marrow sections. Lymphocytes are seen interstitially and also around arterial vessels, in the central parts of the marrow

In an elderly patient with anemia,hemograms, Peripheral blood smears bone marrow examination would ideally be used to exclude or confirm the diagnosis of myelodysplasia or other serious hematolymphoid disease and to help guide therapy. According to an analysis of the Third National Health and Nutrition Examination Survey (NHANES III), 34% of anemia in older adults was due to folate, B12, or iron deficiency

alone or in combination. Iron deficiency is frequently seen in the elderly and usually is a result of acute or chronic blood loss in the gastrointestinal tract.[2,3]

Bone marrow is made up of (a) cellular elements of hemopoietic stem cells, proliferating and differentiating progenitors and morphologically recognizable precursors and (b) stroma. There is a critical interaction between stromal cells and the hemopoietic progenitor cells

Hemogram, peripheral blood smears coupled with Bone marrow aspiration and biopsy are very useful in evaluating for hematological disorders.Aspiration provides cytological details, better morphology and differential cell counts while Bone marrow biopsy provides assessment of cellularity, architecture and is not only essential for diagnosis in ‘‘dry or blood tap’’ but also helps to detect focal lesions.[4]

With increasing population in India, there is a significant burden of hematological disorders attributable to diseases in people aged 60 years and older.No such study reflecting the geographical variation exclusively inthis age group is reported from our region.Little published literature is available regardingthe indication and diagnostic usefulness of marrow biopsies specifically in the elderlypopulation defined as patients 60 years or older.It seems likely that the indications and diagnosesmade, as well as the impact of these diagnoseson therapy, would be different for thissubpopulation. This information is of interest asthe population India ages and the number ofelderly patients undergoing bone marrow studymay increase.

The effect of age on the hematopoietic system has always been an area of clinical interest. Alterations in lymphocyte immunophenotype and function with age have been clearly demonstrated. However, controversy continues to surround the significance of unexplained anaemia in the elderly patient and the extent to which this could be a physiological occurrence.

The present study is therefore, conducted to study the indications and morphological features of bone marrow examination in geriatric population

6.2 REVIEW OF THE LITERATURE

With increasing population of elderly, nearly 23% of the total global burden of disease is attributable to disorders in people aged 60 years and older]. Little published literatureis available regarding bone marrow profile exclusively in geriatric patients.

Of the total world population of 6,464,750, nearly 5,253,484 live in the lesser developed regions, and about two thirds of all geriatric people are living in these developing regions. By the year 2025, this number is going to rise further(5). This shifting demographic trend demands the health care system to get equipped accordingly to serve the present and the future need of the community. Advanced age is considered a risk factor for many diseases and disabilities. The decline in physiological reserve in organs makes the elderly more prone for diseases and have more complications from mild problems.

The process of Hematopoiesis begins in the yolk sac at third week of intra uterine life. From third month onwards, Hematopoiesis starts in Liver which continues up to sixth month. Bone marrow starts taking over the function from fourth month onwards and from then on it is almost the only source of blood cells at and after birth(6)

Bone marrow is made up of (a) cellular elements of hemopoieticstem cells, proliferating and differentiating progenitors andmorphologically recognizable precursors and (b) stroma. There is acritical interaction between stromal cells and the hemopoietic progenitorcells. Islands of Erythroblasts are seen in central parts of the marrow inclose proximity to sinusoids. Myeloblasts are frequently found adjacent tothe trabecular surfaces. Megakaryocytes are normally present in thecentral parts of the bone marrow amongst the erythroid and myeloidprecursors. Monocytic precursors are usually not recognizable in themarrow sections. Lymphocytes are seen interstitially and also around arterial vessels, in the central parts of the marrow.

With increasing age, bone marrow becomes progressively concentrated axially in the central skeleton with reduced cellularity though blood cell counts do not decrease significantly.[7] Aging has

been associated with loss of telomeric DNA from hematopoietic progenitor cells leading to reduced replication as well as blunted response of stem cells to growth factors.[8]

The Aging process is associated with a decline in function of multiple organ systems, such as cardiovascular system, renal system, pulmonary, musculo-skeletal system and notably the hematopoietic process. As age advances, most cells lose their ability to divide, however,the Bone Marrow and gastro intestinal mucosal cells retain their mitotic activity. In infancy, the Marrow is estimated to occupy 80% to 100% of the medullary spaces of long bones and a few flat bones, which gradually shrinks with advancing age decreasing to 50% by 30 years of age, and these further declines to 30% by 65 years of age[9].

Like every organ system, the bone marrow undergoes changes with age. The most readily apparent change is a decline in marrow cellularity. The percentage of marrow space occupied by hematopoietic tissue goes from 40–60% in young adults to 20–40% in older people, with the remaining space being taken up by fat. It is unclear whether the expansion of marrow fat with age is a cause or an effect of aging.

Bone remodeling and osteoporosis can also lead to a decrease in trabecular bone in the marrow. Several age-related changes have been noted in hematopoietic cells, including shortening of telomeres, accumulation of mitochondrial DNA mutations, skewed X-inactivation, and others. However, in the absence of disease, sufficient stem cell proliferation and maturation is preserved so that people are capable of living their entire life span, up to 120 years, without running out of blood cells. Erythropoietin production may be inhibited or interaction with erythropoietinreceptors may be reduced.[10]

Bone marrow biopsy is a safe procedurewith a complication rate of 0.05%[11] .The indications and diagnostic usefulness of bone marrow studies in elderly patients differ from those of bone marrow studies in patient populations composed of children or young to middle aged adults. Studies of general patient populations have shown that the

most common indications for bone marrow study include diagnosis and management of acute leukemia and staging for lymphoma.[12]

Various diseases which can be diagnosed by bone marrow aspiration and biopsy in geriatric patients include : Nutritional anaemiaincluding vitamin B12 deficiency [13],Iron deficiency anaemia, Megaloblasticanaemia, Combined deficiency anaemia[14,15],Anemia of chronic disease[16,17],Pancytopenia [18] Myeloproliferative neoplasm, Chronic myeloid leukaemia, Myelofibrosis, Chronic myelomonocyticleukaemia,Essential thrombocytosis, Non-Hodgkins lymphoma ,Multiple myelomas/plasma cell dyscrasia , Acute leukaemia , Aplastic anaemia, Metastasis ,Idiopathic thrombocytopenic purpura ,Myelodysplastic syndrome[19],Reactive lymphocytosis/plasmacytosis and Eosinophilia, Leishmaniasis[20] Chronic lymphoid leukaemia, Follicular lymphoma, Multiple myelomas,unexplainedanemias[21].MDS have anestimated annual incidence of approximately 3.5 to10 per 100000 in the elderly population.[22]

To understand the various hematological disorders in the old person, it is essential to look into the bone marrow for specific changes, for example the diagnosis, classification and prognostication of MDS is, based on the peripheral blood film and Bone Marrow morphology of the patient. Hence Bone Marrow Morphology remains the cornerstone and most often the gold standard of disease diagnosis and is an important tool that complements cytogenetic findings for prognostic discrimination.

Study done by Harish Chandra et al[23]: Out of the total 721 bone marrow examination performed over the study period, cases above 60 years of age were 156 constituting 21.6% of total cases. The male-female ratio was 1.7:1 with the mean age of 66.2 ± 5.03 years (median of 65) and ranging from 60 to 84 years. Out of the total 156 cases bone marrow, biopsy was not available of 10 cases either due to patient's denial or due to technical difficulty. The most common indication for bone marrow examination in geriatric population was

suspicion of lymphoma (18.5%) followed by cytopenia (17.3%). Normocellular marrow(24.3%) was the most commondiagnosis followed by nutritional anaemia (16.6%) including iron deficiency anaemia, megaloblasticanaemia or combined deficiency anaemia. Total two cases were inadequate for diagnosis as bone marrow aspirate was haemorrhagic and trephine biopsy was not performed due to patient's reluctance. There were cases showing discordance between aspirate and biopsy. These shows that diagnostic discordance was observed in 5.7% of total cases with non-Hodgkin's lymphoma (NHL) being the most common diagnosis missed on aspirate. The aspirate was inadequate/haemorrhagic for diagnosis in total 13 cases while biopsy in a single case.

Study by AnchanaGulati et al[24]: A total of 83 bone marrow aspirations and 82 trephine biopsies were examined along with peripheral blood smears and biopsy imprint smears. Majority of the patients (95%) were in the 60–79 years age group with a mean age of 61 years. Males comprised 56% of the study group with male: female ratio of 1.3:1. In 69 patients (83.2%), bone marrow examination was diagnostic or provided valuable clues for the diagnosis. Of the 69 cases, 65 cases were of hematological disorders and 4 were of non-hematological disorders. Anemia was the most common condition comprising 29 (44.6%) cases and dimorphic anemia was the most frequent(51.7%) subtype. Most of the dimorphic anemia cases revealed megaloblastic and micronormoblasticerythro-poiesis. Aspiration was diagnostic in all cases except in 3 cases of aplastic anemia which were diagnosed on biopsy.There were 15 cases (23.1%) of multiple myeloma and 12 cases (18.5%) of non-Hodgkin lymphoma (NHL) infiltration. Among NHL, 5 cases were of small lymphocytic lymphoma, 2 each of lymphoplasmacytic lymphoma and diffuse follicular centre cell lymphoma. In 3 cases exact typing could not be done. Four (4.8%) cases of leukaemia (2 cases of acute undifferentiated leukemia, 1 case each of hairy cell leukemia and chronic lymphocytic leukemia) and 3

cases of myelofibrosis were also diagnosed .There were 4 cases of non-hematologic disorders—3 of metastatic deposits and one case of Leishmaniadonovani infestation.On bone marrow aspiration, 6 cases were of ‘‘dry tap’’and 5 cases of blood tap. Bone marrow biopsy was diagnostic in all these 11 cases. Bone marrow aspiration findings correlated well with the bone marrow biopsy findings in 73 cases (86.9%). In 11 cases of dry/blood tap on aspiration, biopsy was diagnostic. Among the cases with normal bone marrow study, some of the patients underwent the procedure for workup of NHL infiltration, PUO or raised ESR.

Study by M S Sulkashana et al[25]:During the 16 months period, 164 bone marrow examinations were performed, and 50 patients were at least 60 years old. There were men (27) and women (23), and the age range of the patients was 60 to 82 years. In 30 patients, only bone marrow aspirations were done, and both aspiration and core biopsy was done in 20 patients. In these patients, the hemoglobin levelfrom 3.0 to 10.6 g/dL, platelet count was 20,000 to 1.6 lac/µL, 27 cases (54%) had nutritional anemia(due to iron, Vitamin B12 and folic acid deficiency), 6 cases (12%) were diagnosed to have myeloma, 3 cases (6%) had aplastic anemia, 3 cases (6%) were diagnose chronic lymphocytic leukemia/lymphocytic leukemia infiltrating the bone marrow; 2 cases (4%) had a leukemia, 2 cases (4%) of hypo with myelofibrosis - grade 3 were reported, cases were diagnosed to have m gammopathy of undetermined significance (MGUS) (4%), 1 case (2%) had metastatic deposits from prostatic carcinoma and 1 case (2%) had metastatic deposits from carcinoma - clear cell variant; 1 case (2%) of myelodysplastic syndrome - with multi lineage dysplasia and ring sideroblasts was diagnosed.In this study they found that after nutritional anemia, plasma cell dyscrasias were the most common findings in bone marrow studies in elderly patients.

AIMS &OBJECTIVES OF THE STUDY

To evaluate the hematological disorders ingeriatric patients.

7.MATERIALS AND METHODS

7.1 SOURCE OF DATA

The present 12 months (March 2021 to march 2022) prospective study will be conducted in the Department of Pathology, Dayanand Medical College and Hospital, Ludhiana.

7.2 METHOD OF COLLECTION OF DATA

Inclusion criteria:

The study will include all the patients 60 years and above who will undergo bone marrow examination (aspiration/ biopsy or both) along with Hemogram, peripheral blood smears in the department..

Exclusion criteria:

Patients with age less than 60 years.

Patients in whom bone marrow examination is not done.

Methodology

1) Clinical history, examination and investigations of all identified cases will be taken as per proforma.
2) **Written informed consent will be taken in all.**

This will be a prospectivestudy total for the period of 12 months from march 2021 to march 2022which will be conducted in the Department of Pathology, Dayanand Medical College and Hospital, Ludhiana. Patient's age, sex, bone marrow indication, clinical history,relevantlaboratory and radiological investigations along with bone marrow diagnosis will be noted for every case. The bone marrow aspiration will be primarily done from posterior superior iliac spine and the trephine biopsy will be performed in the same sitting. Imprint smears will be prepared from the biopsy and all the smears (aspiration and imprints) will be air-dried and stained by May GrunwaldGiemsa while biopsy sections will be stained by haematoxylin and eosin stain and reticulin stain. Special stains likeZiel-Neelsen, PAS and GMS,Perlsprussion blue, Masson's trichrome, Reticulin stain will be done wherevernecessary[17]. The hemograms and PBFs of all cases will also be studied and analysed in detailand will be correlated with the

bone marrow examination. Other ancillary tests like flow cytometry and immunohistochemistry will also be included wherever available to reach a definite diagnosis.

Outcome

The study will provide data regarding hematological diseasesin geriatric patients undergoing bone marrow examination along with hemograms and peripheral blood smears.

Statistical Analysis

Data will be described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate.All statistical calculations will done using SPSS (Statistical Package for the Social Science) SPSS 21 version statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

No.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith

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PROFORMA

S.No.: MRD:

Hematology No: Surg. Path No:

Name: Age:

Sex : Date:

Address: Phone no.

Chief presenting complaints:

Duration:
Past history:

Family history:
Personal history:
General Physical examination:
P/A examination:

Indication for bone marrow:

Hemogram :

PBF findings:

Radiological investigations: CT scan/ MRI/ Xray/ PET

Signature of Candidate **Signature of Supervisor**

Bone marrow aspiration

Site

Aspiration.

Cellularity

Erythropoiesis

Leucopoiesis

Megakaryocytes

Myelogram

M:E Ratio
Iron
Bone marrow aspiration diagnosis:

Bone marrow biopsy diagnosis:

Signature of Candidate **Signature of Supervisor**

Other relevant investigation: Serum Iron profile/ Serum B12/Folate

Other infective-etiology work up

Myeloma workup profile :

Cytogenetic studies:

Flowcytometry findings (if any):

IHC findings (if any):

Any other:

Final diagnosis:

Signature of Candidate **Signature of Supervisor**

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o..... .....am willing to participate in the study **"BONE MARROW FINDINGS IN GERIATRIC PATIENTS"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

....

Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य **"BONE MARROW FINDINGS IN GERIATRIC PATIENTS"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"Spectrum of hematological disorders in geriatric patients" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆਂ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ